TQM Volume-11

Total Quality Management
in Factory Management

Process Decision Program Chart

2025a Edition

Kouichi (木村　紘一) Kimura

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Icons:

Notes: Going back to the central theme.

The third level of the Issue provides more clearness to the structure of the text to the more relevant.

Lower levels of the Issue, commonly 6th or 7th, and, pointing out necessary explanations about pictures or graphs.

UPDATING TABLE:

Date, Version-Previous & V-Next	Chapter (I..XX...)	Chapter Point.- sub-point : (Updating)

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SUMMARY

This document, TQM-11, authored by Kouichi Kimura, focuses on the Process Decision Program Chart (PDPC), a fundamental tool for total quality management in manufacturing settings. It delineates two primary types of PDPC: the Forced Connection Type (FCT) and the Sequential Expansion Type (SET). The emphasis is placed on the crucial nature of both and the importance of mastering original techniques over seeking "new" methods.

The Forced Connection Type of PDPC is likened to Industrial Engineering (IE) Work Design and is presented as an application of the Quality Control Flow Chart (QC Flow Chart). Unlike the Process Flow Chart, which analyzes existing tasks, the PDPC aims to predict future problems in new processes and projects, thereby enabling the preparation of countermeasures.

The Sequential Expansion Type, while sharing similarities with Fault Tree Analysis (FTA), has distinct objectives: FTA investigates the root causes of accidents, whereas SET focuses on guiding a plan's execution and preparing for unforeseen circumstances.

It is argued that comprehensive knowledge of all quality control tools is not necessary; rather, mastering a select few, suffices to resolve most issues. The implementation of Six Sigma is critiqued when based solely on statistical data, lacking deep understanding and a company's capacity for sustained effort. Quality is posited as a product of continuous improvement (Kaizen) and an ingrained corporate culture. Finally, the critical importance of "going to the Gemba" (the actual place where work happens) to directly observe the truth is highlighted as the foundation of all endeavors.

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I. Prologue

At this time, I have written about the technique of PDPC (Process Decision Program Chart), which has two different methods. These are the **Forced Connection** type and the **Sequential Expansion** type.

In the US or Europe, this Sequential Expansion type PDPC is more popular than the Forced Connection type. However, the PDPC technique (one of the New QC 7 Tools) is not widely popular overseas, including in the US and Europe. And it is not necessary to be pessimistic about this situation.

The Forced Connection type is the same as the QC Flow Chart. Additionally, the Sequential Expansion type is also very similar to Fault Tree Analysis (FTA) in terms of shape and deployment.

A clever person or scholar wishes to create something new. But please think carefully, most of their "something new" is not "new" but the same or a slight modification of existing methods.

I need to write repeatedly, rather than seeking new methods, you need to master the original techniques.

For instance, QC 7 Tools employs the Fish-Bone technique.

QC 7 Tools.

It is a relatively old and basic technique. And I ask you, can you use this Fish-Bone? …Sorry, but I dare to say to you that I haven't seen a good Fish Bone Deployment in companies. They know the name. But they cannot use it.

You can use the 5 Whys thinking deployment. I don't like 5Whys. Why? The 5Whys deployment has only one category for each defect. However, Fish Bone should have many categories, with numerous branches. And one branch also has many categories, 5 Whys. One defect often has multiple causes and is rarely caused by a single category. Therefore, when you encounter a quality problem, consider the causes from multiple dimensions.

The "5Why method" method cannot identify one defect from various perspectives.

Six Sigma.

Please understand that the success stories of other companies can never be your own success story. Each company has its corporate culture and existing capacity. Regarding Six Sigma, yes, it was developed by Motorola. However, can the verb be used to develop the correct one? …No, it is not. It is a modification. One key advantage of Motorola was its customization of one part of the TQC (Total Quality Control, also known as Companywide Quality Control, as developed by Kaoru Ishikawa).

Once again, please master the fundamental technique sufficiently just because there are too many unnecessary techniques out of there.

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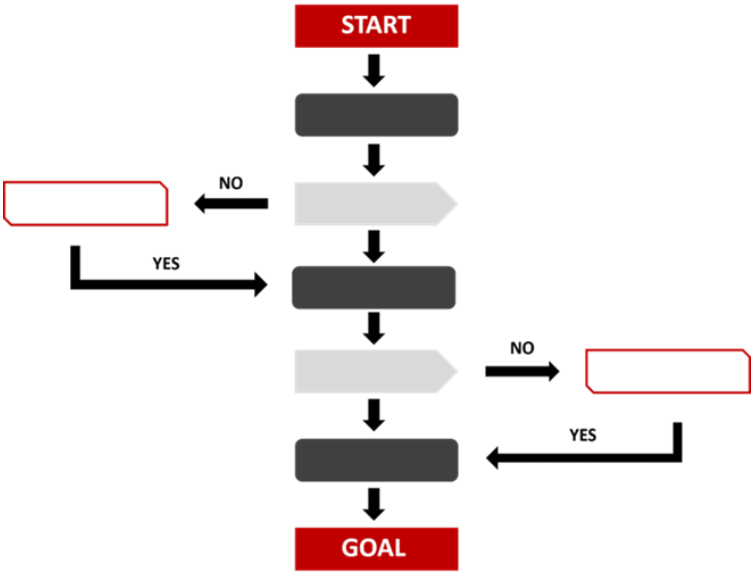
II. PDPC – Process Decision Program Chart

Difference between Work Design and PDPC

First, I want to inform you that PDPC has two types; One is **Forced Connection Type** (FCT). Another is **Sequential Expansion Type** (SET).

1. Work Design and Forced Connection Type of PDPC. Different?

In TQM-4, I briefly addressed this subject using the following figures.



Additionally, I explained that the FCT of PDPC is the same as, or very similar to, the Work Design of IE (Industrial Engineering).

I will explain it in more detail. However, the following are the detailed steps of Work Design:

0. Forming a team and creating an environment for communication
1. Deciding on a theme
   First, clarify the theme of the work or process you want to improve. This will determine which part to focus on.
2. Clarifying the purpose of the system
   Next, clarify the purpose and function of the work design. This will set specific goals for improving work efficiency and quality improvement.
3. Setting the ideal.
   Set goals, optimal process.
   Set specific goals for implementing improvement proposals. This will provide a standard for measuring the progress of improvements.

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4. Current situation analysis. Analysis of the gap with reality and visualization of the processes. Analyze the current work process in detail. Collect data such as work time, process flow, and defect rate to identify issues and bottlenecks on the site.
5. Consideration of feasibility
   Automation, AI & IT, robots, collaboration with humans, and the balance of these, along with a skills-based approach.
6. Consideration of improvement proposals.
   Optimize tasks, utilize digital tools, consider ergonomics, and consider mixed-mode manufacturing.
   Consider improvement proposals based on the collected data. This includes reviewing work procedures and introducing new technologies.
7. Implementation and evaluation.
   Building a feedback loop that considers sustainability.
   Implement improvement proposals and evaluate the results. Check whether they were effective and make further improvements if necessary.
8. Standardization
   Successful improvement measures are documented as standard work and incorporated into the overall work process. This enables continuous improvement.

When listing up the work procedure, it can be called a technique. And, it can also be named one of the thought deployments. In fact, this Work Design deployment is identical to the Process Decision Program Chart.

I listed up the detail process of Work Design. And next, I listed up the process of FCT Chart.

1. Clarify the purpose and set a theme (Above, 1,2 and 3)
2. Decide the start and goal (3)
3. Decide the shortest route (3)
4. Consider points where unforeseen circumstances may occur (4 and 5)
5. Consider countermeasures for unforeseen circumstances (4,5, and 6)
6. Implementation (7 and 8)

To confirm my point of view, I asked AI (Genspark). And I got the following answer:

Analysis and optimization steps are similar.

PDPC and IE work design are very similar in their deployment methods (tree structure, stepwise approach, branching analysis).

The difference is that PDPC focuses on risk management and decision-making, while IE work design focuses on optimizing work and improving efficiency; however, both share the fundamental idea of deploying, analyzing, and improving processes.

I created the following table to outline the steps of PDPC and Work Design.

Step		FCT of PDPC	Work Design
1	Identify the current situation	Check the process flow and identify significant steps	Conduct a work analysis and check the workflow.
2	Identify problems and issues	Identify problems that may occur at each step	Identify waste and risk in work.

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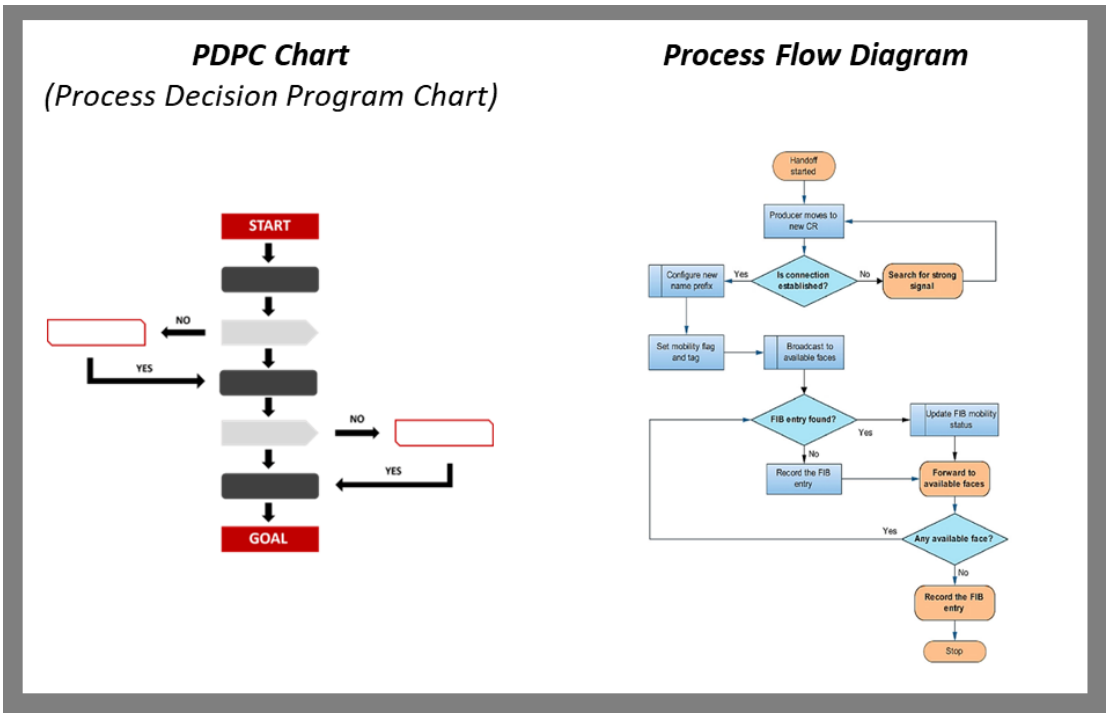
3	Detailed development	Hierarchically develop strategies and countermeasures to address problems that occur.	Break down work operations in detail and examine the optimal combination of these operations.
4	Improvement and Optimization	Determine optimal countermeasures and create an action plan.	Design efficient operations by utilizing the principles of operating economy and standardization.
5	Standardization and continuous improvement	Standardize optimal processes and prevent problems from occurring.	Standardize work methods and continuously improve them.

2. QC Flow chart and FCT of PDPC. Different? QCフローチャートとの違い (Differences from Flowcharts)

By the way, when looking at the flow chart of FCT, do you recall the following flow diagram, don't you?



This is one of the **Process Flow Diagrams** (from SNS).

That's right. FCT is one of the Process Flow Diagrams of IE. However, the Process Flow Diagram and Forced Connection Type of PDPC (Process Decision Program Chart) differ.

A **Process Flow Diagram** is a method used to visualize and analyze current tasks and processes, identifying waste and inefficiencies.

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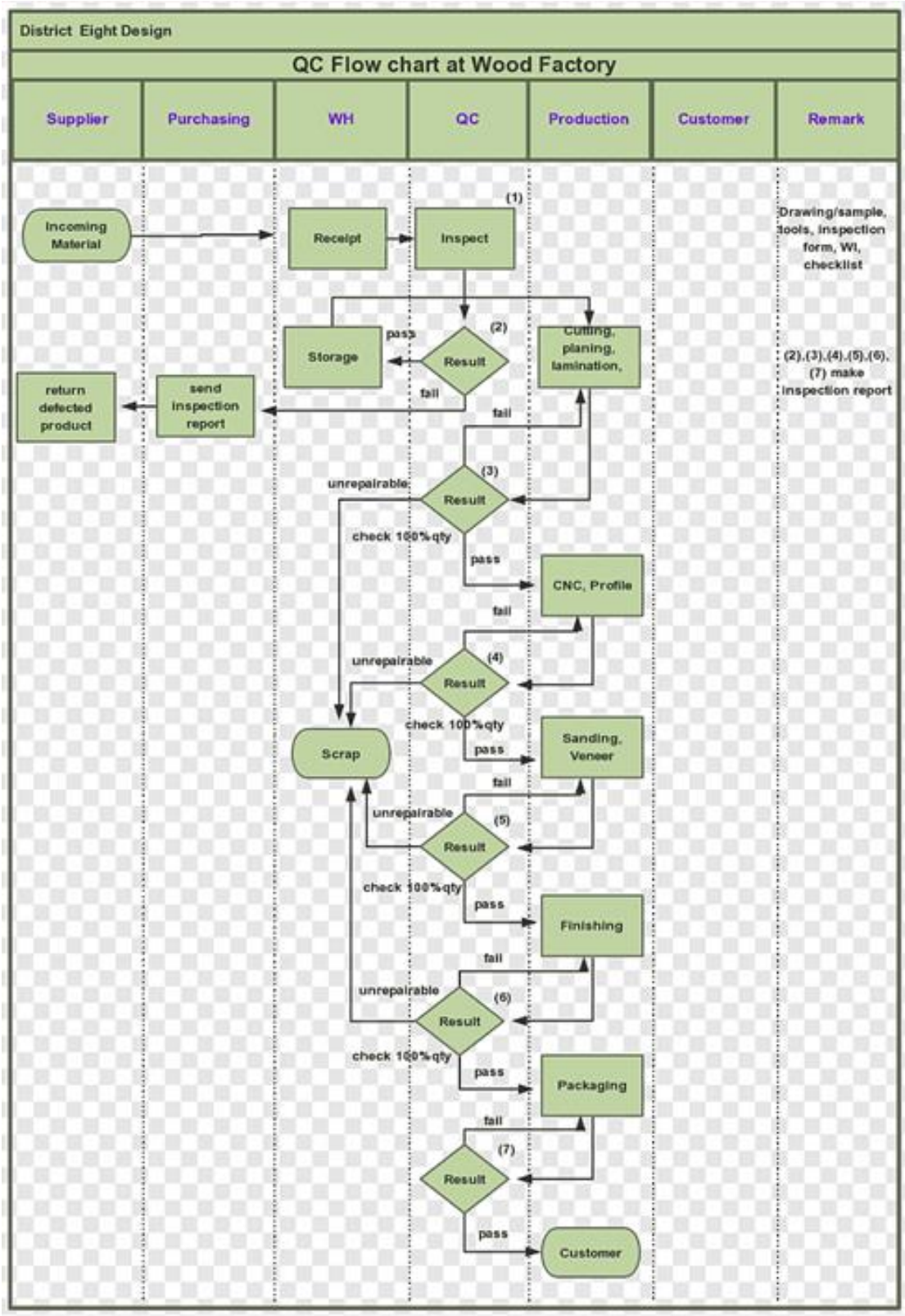
A **PDPC** is to predict problems that may arise during the implementation of new production processes, projects and plans, and take measures to address them. PDPC is (I can say that) the combination of the **Process Flow Diagram** method and **Work Design**. Please look at the following figure.



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Hum? … That's strange. This shape is very similar (or the same) as FCT, isn't it?

There is a slight (or significant) difference. It is the same as the Process Flow Diagram of IE. To help you understand PDPC, I provided the table below.

KEY DIFERENCES		
Item	**QC Flow Chart**	**PDPC Method**
Aim	Understand the current process flow and identify areas for efficiency and improvement.	Anticipate risks and problems in your plan and develop countermeasures.
Perspective	Gain visibility into current processes and procedures.	Anticipate future problems and risks and detail your plans.
Structure	Flow diagram (linear or branching)	Flow diagram (linear or branching) (Same to left)
Focus	Efficiency and improvements in processes and procedures.	Possible problems and how to deal with them.
Use	Optimize business flow and visualize work procedures.	Risk management for project planning and new product development.
Symbol	Uses standard flowchart symbols.	Uses standard flowchart symbols.

PDPC and QC Flow Chart. Are these different? I say "Same". And PDPC is one of the applications of the QC Flow Chart.

The history of the QC Flow Chart is quite old, and please read the following Note:

History of QC Flow Chart

Let's examine the history of QC flowcharts. QC flowcharts are one of the quality control methods used to represent manufacturing processes and business flows visually. Its history is closely related to the development of quality control.

In the 1950s, American statistician Edwards Deming introduced quality control methods to Japan. Deming preached the importance of quality control using statistical methods, which had a significant impact on Japanese manufacturing.

Later, in the 1960s, Kaoru Ishikawa made significant contributions to the development of quality control in Japan. He developed methods known as "fishbone diagrams" and "seven QC tools," which played a crucial role in the practice of quality control. In particular, flowcharts came to be used as a tool to facilitate the identification of problems by visualizing the flow of processes.

Since the 1980s, the concept of company-wide quality control, such as Total Quality Management (TQM), has gained popularity, and the QC flowchart has played an essential role as part of this approach.

There are further important events and developments in the history of QC flowcharts.

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In the late 1950s, the QC circle movement in Japan began. This is an activity in which workers on the front lines voluntarily get together to work on quality improvement, and the QC flowchart played an essential role in this activity. QC circles are recognized as an effective means of disseminating quality control methods throughout the workplace and have contributed to improving the quality of companies.

In the 1980s, the international quality standard ISO9000 series was established, and this positioned the QC flowchart as an essential tool within the global quality control framework.

In recent years, with the advancement of digital technology, QC flowcharts have become easier to create and share through software and applications. They are being used for real-time data analysis and improvement activities.

As I wrote before; It was in the 1980s that the Union of Japanese Scientists and Engineers announced the New QC 7 Tools. But once again, I dare to say that PDPC is an application of QC Flow Chart or Process Flow Diagram, combined with Work Design thinking.

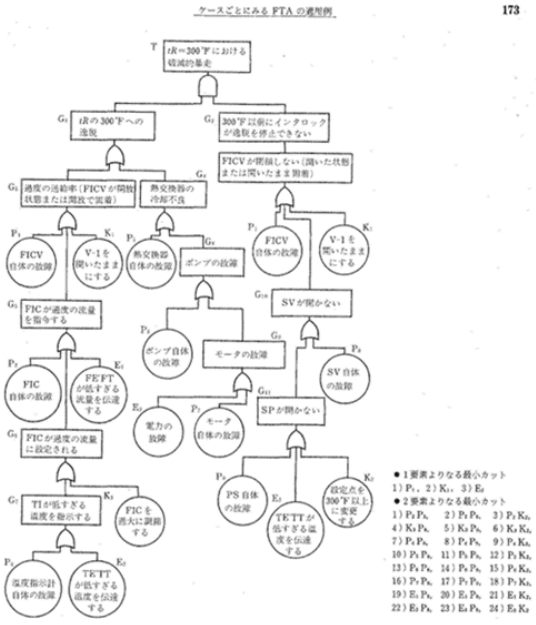
3. Sequential Expansion Type of PDPC and FTA (SET vs. FTA)

TQM-7 The new 7 Quality tools and the Tree Diagram

By the way, this technique SET of PDPC is not popular in US. Strange? Because the original is US (Work Design, QC Flow Chart). I have got a question about it by US friend. And at this time, I was informed it is not popular in US. But everybody knows the name, but not use it.

However, when searching for PDPC, you can find many documents including short movie lecture. And the contents are all (it is possible to say all.) Sequential Expansion Type (FTA or DTA type). But PDPC, including SET, is not popular in the US.

Work Design thinking of IE. It is made in US. QC Flow Chart or Process Flow Diagram in IE is also made in the US.



He explained another reason why PDPC isn't popular in the US.

As I describe below, PDPC has a Forced Connection type and a Sequential Expansion type.

Similar methods are used in the US and EU, but the specific implementation methods and names are often different. In particular, in the US, "Decision Tree Analysis or Fault Tree Analysis" and "Failure Mode and Effects Analysis (FMEA)" seem to be widely used as frameworks for evaluating risks and taking measures.

(By US friend)

Decision Tree Analysis (DTA) and **Fault Tree Analysis** (FTA) have already been explained in TQM-7.

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Of course, these are different. But it is possible to say that DTA is one of the applications of FTA.

Humm? It is also very similar to SET of PDPC.

Fault Tree Analysis (FTA)

Objective: *To evaluate the safety of a system by logically extracting the cause-and-effect relationships that lead to serious failures and accidents (top events).*

Approach: *Using a "top-down" approach, working backward from the top event, the causal events are sequentially decomposed, and logical gates (AND, OR, etc.) are used to show which combinations create risk.*

Execution-oriented PDPC

Objective: *To identify in advance problems and obstacles that may occur at each stage of a project or plan, and to prepare specific countermeasures against them.*

Approach: *A more sequential approach to scenario planning, in which "what-if" situations are assumed at each stage, and risks are identified and countermeasures are considered each time.*

Similarities and Differences between Breakdown Thinking

Commonalities: *Both breakdown thinking methods are similar in that they both break down a large problem into smaller elements to get a complete picture. Both use a "tree structure" to visually organize complex phenomena.*

Differences: *The primary difference is that they both utilize a "tree structure" to organize complex phenomena visually.*

Different objectives*: FTA logically pursues the chain of causes to understand "why accidents and failures occur.*

PDPC organizes risks and countermeasures at each stage sequentially in order to consider "how to proceed as planned and prepare for unexpected situations.

Process Direction:

FTA is a top-down, results-to-cause, backward-looking approach.

SET is a more sequential, process-oriented approach that develops "what if" scenarios at each stage of the process and creates scenarios for countermeasures.

Thus, even though the basic framework of subdividing the whole remains the same, the approach varies significantly depending on where the emphasis is placed - on cause analysis or the preparation of countermeasures, for example.

A clever person wishes to create or present a new method. But in fact, most of the cases, these have an exact origin or only the application.

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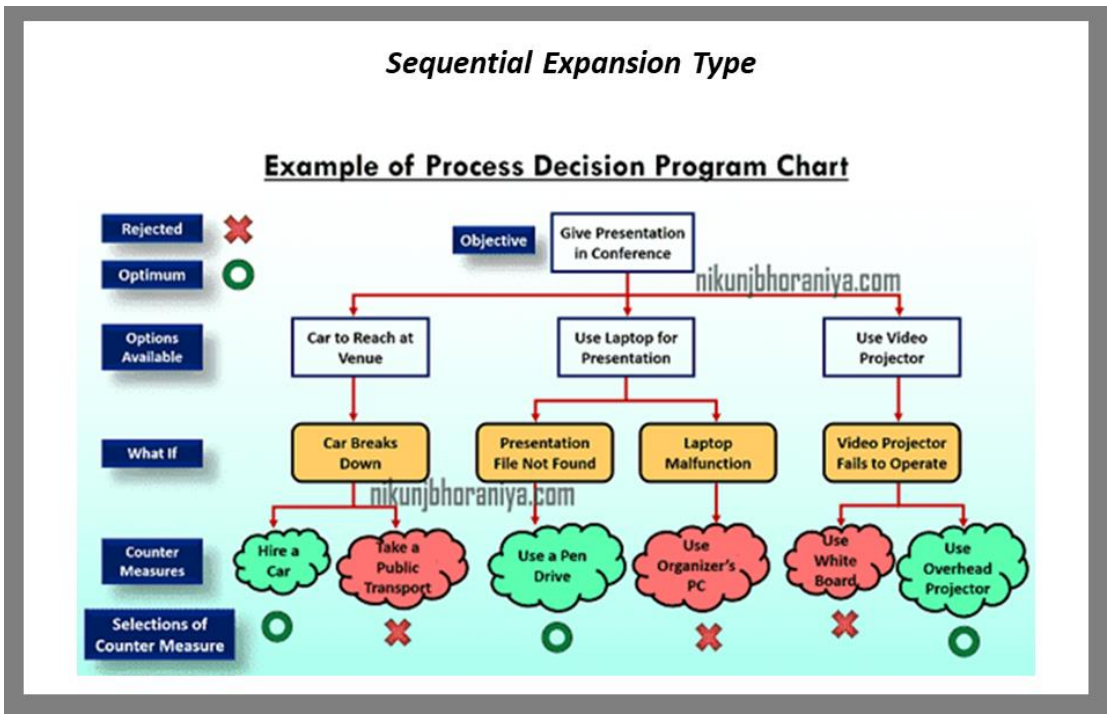
However, I recommend using these for your potential problem (risk) management, leveraging your creative thinking. Any methodology will do. But just creative thinking is your difficulty.

FCT of PDPC making… Please, try to make FCT…

4. PDPC – FCT vs SET.

Now, after a lengthy introduction, let's study the method of PDPC; Once again, PDPC has two types: **Forced Connection Type** (FCT) and **Sequential Expansion Type** (SET). And there are both born in Japan.

Once again, when examining the examples in SNS, there is only SET in the US and the EU. The image is as follows, which is the same deployment of DTA or FTA.



And next, I introduce FCT under my experience:

Next is one of example of **Forced Connection Type** (FCT): Long years ago, yes 1960s, my first mission and job were chief of IE (Industrial Engineering). And I have got the training in Sumitomo Electric. After this training, I used these IE methods for my plant. And I used the PDPC which was the combination of Process Flow diagram and Work Design.

On the other hand, PDPC in the New QC 7 Tools were announced by the Union of Japanese Scientists and Engineers at 1980s.

Even though I'm writing such a story? …Well, if you wish to learn such a PDPC technique, you can buy a textbook. But such a thing may not be so interesting. In contrast, my wish is for you to read my documents because of your interest. Consequently, you can ignore the PDPC of New QC 7 Tools.)

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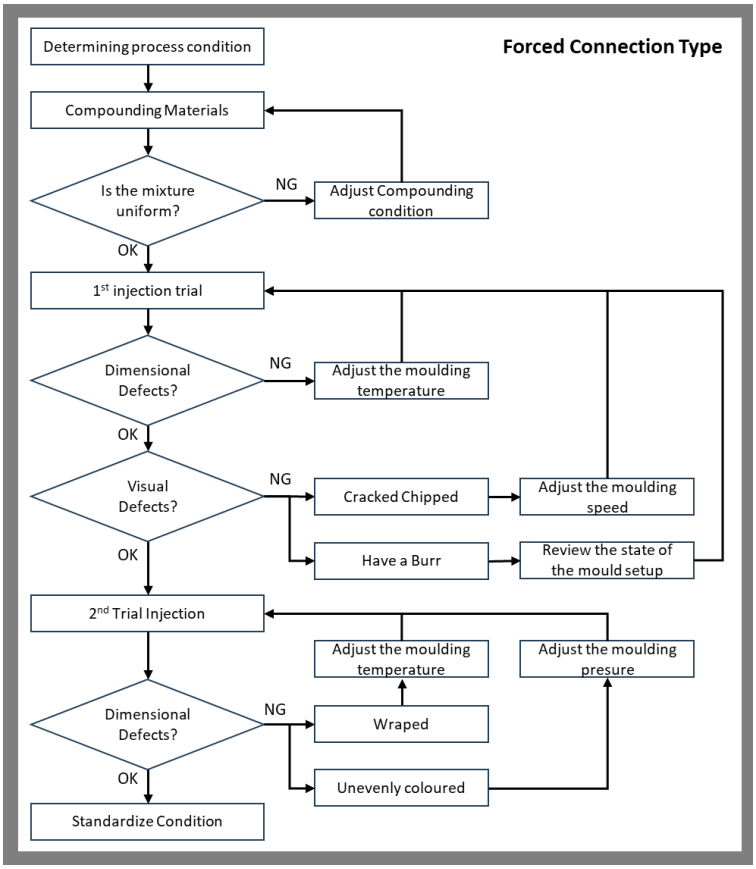
The figure of the right is my FCT ➔



a) Forced Connection Type (FCT).

Again, what is PDPC (Process Decision Program Chart)

I explained the similarity of QC Flow Chart, Work Design of IE and PDPC. And for your good understanding, I explain PDPC by comparing QC Flow Chart.

Although both QC flowcharts and PDPC methods are useful tools for process management and problem solving, there are clear differences in their purposes and how they are used.

First, a QC Flow chart is a diagram for visually showing the flow of a process. It is used to show each step of a work in an orderly manner and make it easier to understand how it will proceed. QC Flow Charts are especially useful for standardizing and improving manufacturing and service processes.

On the other hand, the PDPC method (Process Decision Program Chart) is a technique for predicting obstacles and problems that may occur in the process of achieving a goal and planning measures to deal with them. In the form of a flowchart, the PDPC method identifies risks and obstacles at each step and shows alternatives for them. This makes it possible to prepare for unexpected situations.

Specifically, the QC Flow Chart shows the flow of a process, while the PDPC method focuses on risk management within that flow. While the QC Flow Chart shows "what to do," the PDPC method shows "what may happen" and "how to deal with it." This makes the PDPC method especially effective in planning projects and new processes with high uncertainty.

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The steps of FCT of PDPC.

I introduce the case of my factory example for describing it.

Step-1: **Clarify the purpose and set a theme:** Decide the injection molding condition of new material

Step-2: **Decide the start and goal:** Set the start and goal of the plan.

In this example, we'll set the start as "Decide injection molding conditions" and the goal as "Confirm processing conditions."

Start: Determine processing conditions.

Goal: Standardization of processing conditions.

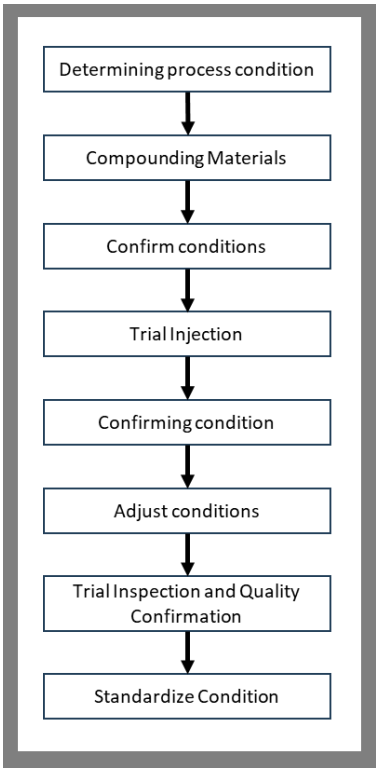
Step-3: **Decide the shortest and ideal route:** Next is to create an ideal route that connects the start and goal in the shortest possible way.

Basically, you just need to list the actions to be taken in order, but it's a good idea to keep in mind the distinction between "measures" and "checks" in preparation for thinking about unforeseen circumstances later.

In this example, we've roughly categorized the actions into "adjusting parameters" and checks into "checking the results."

Below is my experience using it.

1. The first assumption process (ideal process) is at the right picture ➔
   - ⇨ This is the ideal flow for confirming and standardizing the setup condition of the injection moulding machine.
2. Assumed problem: I considered the assumed problems and drew the next chart ➔
   - ⇨ As you see, the assumed problems have NG and OK. (Deleted the box of “Confirm Condition”).
3. Consider points where unforeseen circumstances may occur.
   - ⇨ Once the shortest route has been decided, consider points where unforeseen circumstances may occur and indicate them as branching points with diamonds.
   - ⇨ The items indicated in the "2nd Inspection" section above need to be added to the branching points that will determine pass/fail.
   - ⇨ Also, if there are multiple check items, line up multiple diamonds so that they branch out for each one. Let's look in my example.



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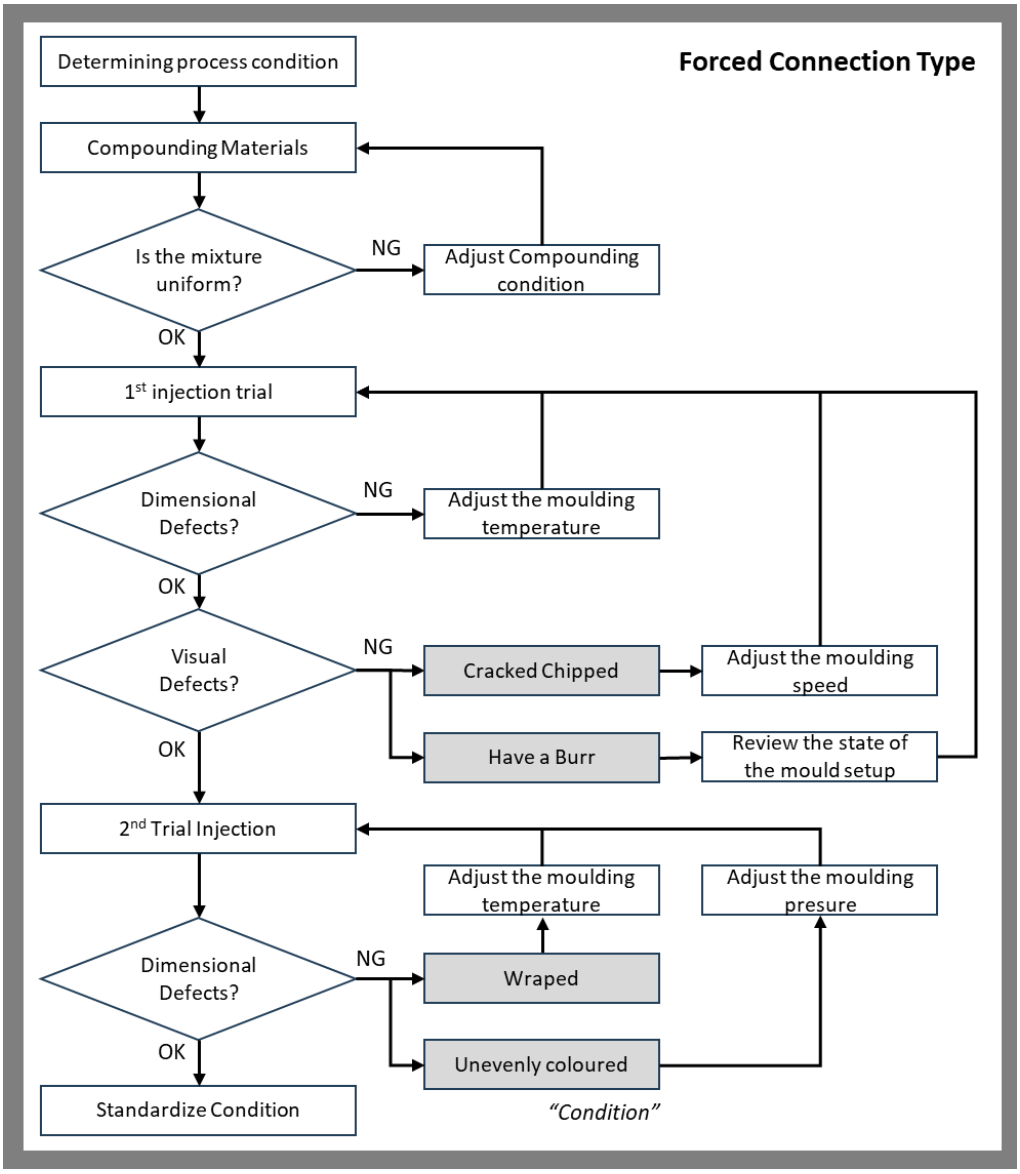

Total 10 processes. (Deleted the box of Re-Compounding Material.)

Step-4: **Consider countermeasures for unforeseen circumstances:** Furthermore, write down countermeasures (solutions) for unforeseen circumstances.

If a branching point is judged to be non-compliant, readjust the conditions and follow the same procedure to return to the same route.

Also, as shown by the circles, if you divide non-compliant states (failure modes) into multiple states, you can take appropriate measures according to the state.

As you know, the items of NG have the "Condition" and "Arrow for countermeasures" are drawn.

Step-5: **Check total:** Finally, check that the arrows are not crossed and, if it is a forced connection type, that arrows connect all items. Then, tidy up the format and you're done.

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A little more…

Key points for creating a PDPC

I. Determine the prerequisites

The PDPC is an effective method for comprehensively organizing contingencies, but if you list everything, the whole thing will become too expansive and it will become difficult to discern the essence of the problem.

In cases like this, it is effective to determine the prerequisites for the measures in advance.

For example, if there are limitations on the measures, such as money, facilities, or people, you can list these as prerequisites at the beginning and then remove these from the PDPC to organize things neatly.

II. List the elements

If any items are missing from the flowchart, the countermeasures will not be appropriate.

Therefore, rather than jumping right into writing the flowchart, I recommend that you carefully consider everything in advance and make a list of the elements.

My recommendation is, of course, to use KJ.

In the case of the manufacturing conditions example introduced earlier, if you categorize and organize the following, you can proceed quickly when illustrating it.

- ⇨ Countermeasures (square): Adjustment parameters.
- ⇨ State (circle): Failure mode.
- ⇨ Branch point (diamond): Check items.

III. Leave supplementary explanations

Flowcharts have the advantage of looking neat and easy to understand, but when they are kept as information assets, they often lack explanation. Thus, if any parts of the flowchart require additional explanation, such as the reason why a check is necessary or the guideline for pass/fail judging, it is a good idea to keep them as supplementary material together with the KJ.

As you see, it is not difficult to deploy. This is the FCT of PDPC (Process Decision Program Chart).

By the way, the literature introduces the following uses of the FCT of PDPC method. The PDPC method is used not only in manufacturing and project management, but also in various industries.

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Examples include risk management during the product development process and trouble shooting in event planning. This reduces uncertainty during the execution of plans and allows them to proceed more effectively.

Product development process and troubleshooting in event planning.

But I say that this method (FCT) is not suitable for complicated and/or long processes (for instance) of new product line establishment.

For example, a new car production line deployment (please assume the Press process of Toyota).

The press process has 100~300 processes.

Can you imagine that it is possible to deploy this FCT of PDPC for assumed problems and countermeasures for many complicated processes? …If we use this method, what a long QC Flow Chart should be assumed! … The assumption about the car production line is too exaggerated.

See you then, how about the new production line of car wiring harness (which is my experience in a previous company). The processes involve material gathering, cutting cables, assembling, inspection, and delivery.

There are more than 30 processes. Additionally, wiring harnesses have many kinds of connectors & terminals, and cables. It encompasses the meaning of various variables and numerous assumed problems.

No, no, no. Even the wiring harness process is challenging to implement this PDPC method. Logically, it is possible, but in reality, it is not.

I believe you can imagine that this method is not suitable for a long production line; however, it is only suitable for straightforward and short processes. Then, in reality, it is possible to use for a simpler theme, such as my injection moulding material example.

Toyota car manufacturing process.

Main processes in Toyota's passenger car production line

Based on the Toyota Production System (TPS), the manufacturing processes are broadly classified as follows.

Press Process

> *Steel sheets are formed using presses to produce the individual body parts (doors, bonnet, etc.).*
>
> *Number of processes: approx. 100-300*

Body welding process (Welding)

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Body frames are assembled by welding pressed parts.

Many robots are in operation (high rate of automation).

Number of processes: approx. 1,000-3,000

Painting process (Painting)

Painting, including anti-corrosion treatment, primer coat, main coat and finishing coat.

Strictly controlled in a clean room environment.

Number of processes: approx. 500 - 1,500

Assembly process (Assembly)

Installation of engine, transmission, interior, electrical components, glass, etc.

Involves many workers and robots.

Number of processes: approx. 3,000-10,000

Inspection & Testing

Visual inspection, functional testing, driving tests, etc.

Number of processes: approx. 500 - 1,500

Shipping & Logistics

Prepares finished vehicles for shipment and transports them domestically and internationally.

Number of processes: approx. 200-500

Approximate total number of processes

Considering the total of each process, it is estimated that there are approximately 5,000 to 15,000 processes involved in the manufacture of a single passenger car.

I don't deny using this method. If you like, you can use it. But it is necessary to have additional essential work. It is the subdivision of complex processes.

And it is necessary to make the Forced Connection Type PDPC for individual processes subdivided.

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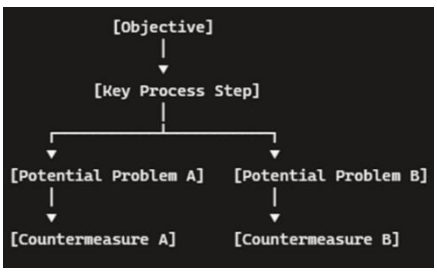
5. PDPC – Sequential Expansion Type

I'll write a detailed later about the PDPC-SET, I know it, but let me touch on it a little.

Below is a summary of the typical steps for executing the PDPC (Process Decision Program Chart) method. The PDPC method is designed to help you proactively map out potential problems and devise countermeasures for each step in a process. Here's a step-by-step breakdown.

1. **Define the Objective and Success Criteria.**
   Clearly articulate your end goal.
   Specify what constitutes success so that all subsequent planning is aligned with this target.
2. **Identify and List the Key Processes**
   Outline the major activities or phases required to achieve the objective.
   Develop a rough flow of the overall process (often in the form of a high-level flowchart).
3. **Develop a Detailed Process Flowchart.**
   Map the key process steps sequentially.
   Identify decision points or critical junctures where the process either continues smoothly or may encounter issues.
4. **Identify Potential Problems Step-by-Step.**
   For each process step, ask "What if something goes wrong?"
   Document the possible failure modes, obstacles, or risks. This is the "risk identification" phase.
5. **Expand Each Process Step into a Risk Tree.**
   Break down each identified risk further into a cascade of potential failure events.
   This step uses a tree-like structure to show how one failure can trigger subsequent issues (the "if this happens, then that will happen" approach).
6. **Develop Countermeasures and Contingency Plans for Each Risk.**
   For every potential failure branch, list possible actions or strategies to mitigate the risk.
   Detail preventive measures (to avoid the risk) or corrective actions (to manage the impact if the risk materializes).
7. **Review and Validate the PDPC Chart.**
   Engage a cross-functional team to review the chart.
   Validate the logic of the risk paths and the feasibility of the countermeasures, etc. Adjust based on feedback and any simulated scenarios.
8. **Implement, Monitor, and Update.**
   Incorporate the PDPC into your execution plan.
   Monitor the process during implementation to see if risks emerge as predicted.
   Regularly update the PDPC to reflect any new insights or changes to process conditions.

Visual Illustration of the PDPC (Process Decision Program Chart) Process. The following is a simple ASCII diagram that illustrates the flow of the PDPC process:



…From SNS Copilot ➔

Sounds like a hassle? …No, no, no. Not at all. And it is easy.

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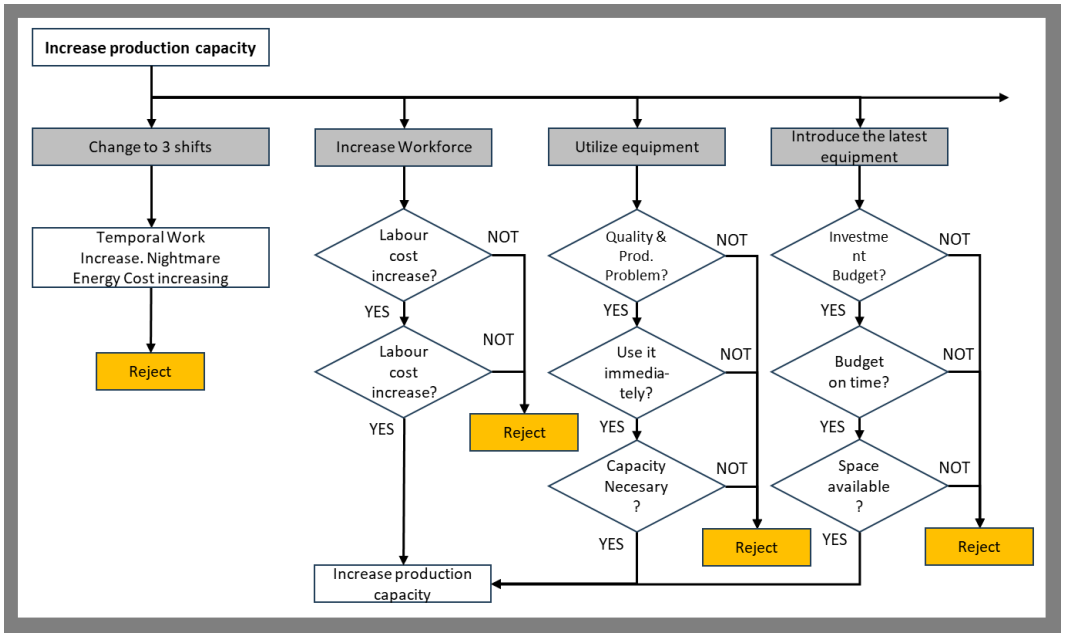
In my case, I recall a long time ago, when I was the production department manager, I faced a severe shortage of production capacity. Due to the customer's demand, the production plan fluctuated.

The problem area was cut & Crimp. Other processes, such as sub-assembly and assembly, could be shared with subcontractors. However, the Cut & Crim process requires specialized equipment and raises concerns about quality. Therefore, this process had to be resolved in-house.

Then, to overcome this temporary problem, my team made the next diagram. (Actually, KJ diagram. Next is the remake from this KJ.)



These more than 300 ideas (cards) were condensed into 12 key points (islands).

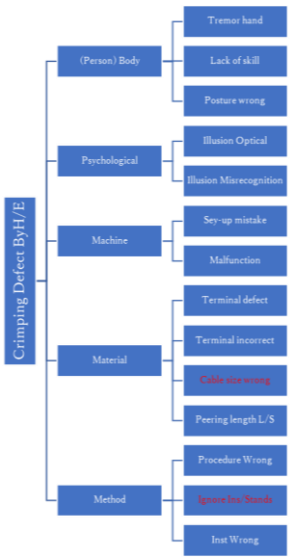
Other islands (than the above 4) were, "Negotiate with the customer to change production schedule, Put the idle machines in a subcontract, Ask for help from Competitor companies, etc.". (I omit to draw these in the following example chart.)

As a result, the above three ideas (islands, increase workforce, Utilize Idle Equipment, and Introduce Latest Equipment) were selected as candidates for countermeasures.

When reading the SNS explanation, following words are added:

> *This method is effective when you are unable to narrow down a large number of candidates. It is recommended to learn how to use the PDPC method to narrow down the candidates extracted by the system diagram (Tree diagram) method of the 7 New QC Tools.*

The right Image is from a System diagram (Tree diagram) (From TQM-7)



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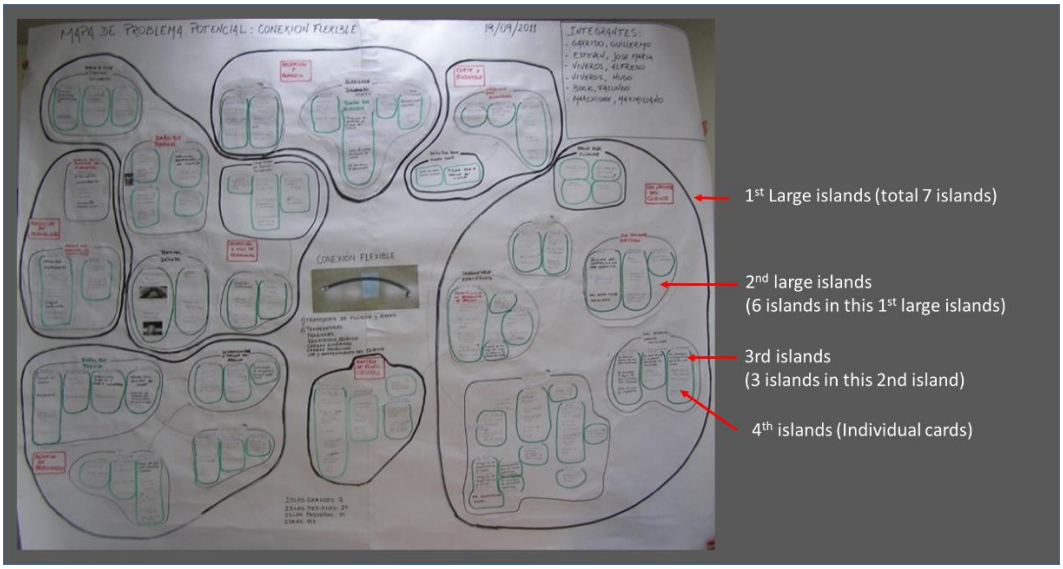
Now, what is the most difficult process to create a SET of PDPC? …As you understand, it is the process of creative thinking which you need to create the countermeasures and the assumed concerns.

And I said that the above example is re-made from the KJ. And, I said in the column of the Tree Diagram in TQM-7. Again, is a SET of PDPC necessary?

Which is better for your creative thinking? KJ or PDPC? …It is your choice. But I never recommend PDPC.

TQM-7 7New QC tools & the Three diagram

Below is from TQM-5. Below is an PPM (Potential Problem Map by KJ)


1st Large islands (total 7 islands)
2nd large islands
(6 islands in this 1st large islands)
3rd islands
(3 islands in this 2nd island)
4th islands (Individual cards)

By the way, in this SET of PDPC, 3 islands were nominated as countermeasures for a temporary but severe production capacity shortage. There was an increased workforce, Utilize Idle Equipment and Introduce the Latest Equipment.

So, what did I choose? …I chose just Increase Workforce. How did I overcome this problem? …The problematic process was Cutting & Crimping by an automatic machine.

TQM-5 The KJ Method

The countermeasures were 3:

- ⇨ One way was to use machines all hours. Nonstop at lunchtime by the office staff. The equipment consisted of fully automatic machines, excluding the quality check and a 100-lead unit tie-up. The office staff worked just above.
- ⇨ One was overtime work, including Saturday and Sunday, by operators.
- ⇨ The last one was overtime work by administrative managers, including the Managing Director.

And I became famous overnight as the person who drove the Managing Director to the predicament production.

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TQM-3: TQM Hardware, Software and Diagnosis

Are new QC 7 tools needed?

By the way, as I mentioned above, PDPC has two different types: one is the Forced Connection Type (FCT). Another is the Sequential Expansion Type (SET).

I'm currently writing the New QC 7 Tools and PDPC method. But please don't miss the current position. However, I also wrote about TQM Software and Hardware in TQM-3.

Once again, TQM Software and Hardware, I wrote as next in TQM-3:

Three different aspects in Software-TQM

1st aspect: The production flow.

It involves planning of New products, Product development, Production design, Production line formation, Production Planning, procurement and warehouse management, Production, Delivery line and delivery to the customer, customer production, and customer satisfaction (CS).

By the way, in the first aspect, I will write from the Product Development perspective and omit the initial process (Planning of New Products). However, I add if needed.

2nd Aspect: The organization from the bottom (Genba workers) to the top (Executives).

I will omit the second aspect, because I have already written the role of management. Anyhow, I can rewrite if needed.

3rd Aspect: System of Policy Control

From corporate philosophy to long-term and short-term plans, annual policy, and annual action plan. System of "All People's Participation", Working environment (Employee engagement & Moral formulation & improvement, Thinking environment).

In the above third aspect, I will omit the items of Systems of Policy Control, Systems of "All people's participation, Employee engagement & Moral formulation & improvement.

Because I already wrote these in TPM-10 and in other columns. Therefore, in this third aspect, I will write just **the thinking environment**. Anyway, I also write if needed.

TPM-10: Employee engagement

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TQM Hardware

TQM has many tools. And, I call such tools as TQM Hardware. And the tools are as follows: 7 QC tools, QC Circle, Kaizen Process Diagram, Potential Problem Matrix, QCPD (Quality Control Process Diagram), FMEA, QA Matrix, Function Deployment, IPQC (Initial Products Quality Control), QRQC (Quick Response Quality Control), Taguchi method and KJ method. I will write these in the TQM series. Actually, we could add more if needed.

New QC 7 tools, QC 7 tools and KJ method

I omit to write the New QC 7 tools.

I know that it is natural to write the New QC 7 tools as the TQM tools. However, I don't take this up because there are too many. Yes, too many. Rather than knowing many tools, it is crucial to use a limited tools sufficiently. And, I believe that it is possible to resolve most of the quality concerns with the above tools (from the 7 QC tools to the KJ method).

The New QC 7 tools are as follows: Affinity diagram method, Association diagram method, System diagram method, Matrix diagram method, Arrow diagram method, PDPC method, ***Matrix data analysis method****.*

The QC 7 tools are: Pareto charts, Histograms, Scatter plots, ***Fishbone diagrams****, Check sheets, Graphs, and Control charts.*

Generally, it is said that QC 7 tools handle quantitative data, while New QC 7 tools handle qualitative data; however, this is not entirely accurate. For instance, a Fishbone diagram is used to treat qualitative information. For example, the Matrix data analysis method treats quantitative data, despite being one of the New QC 7 tools.

I have stated that I will omit writing about the New QC 7 Tools. However, I'm writing it now. Actually, I changed my mind at the request of some friends. And I gave two reasons: One is that I wrote that "And I believe that it is possible to resolve most of all quality concerns by the above tools (from 7 QC tools to KJ method)". Then, I'm denying the effect of New QC 7 Tools. I've even gone so far as to say it's not necessary. And some friends rebel against my words. Another is that even using these techniques, there is a limit.

Are there limits to the use of the New QC 7 tools? Let me introduce a real case.

A story of a company (A Company's Story about a Six Sigma Project)

Introduction

Now, let's move away from these PDPC topics for a bit. However, in my heart, I don't like such unusable QC technique. I have introduced the topic of QC technique junkie (technique acholic) in somewhere.

This company is eager to improve quality through quality control (QC) techniques. They are pretty familiar with these. However, the quality

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improvement result wasn't so good. Then this company asked me about the TQM teaching. What was the problem?

According to my diary, the following outline of dialogue was recorded. The purpose of this dialogue was to identify the main way to resolve this company's quality concerns.

After looking around the factories, I had a dialogue with the QA Manager (QA) and his Quality Staff (Qfs). On the wall of the meeting room, certificates related to quality techniques were displayed.

—Oh, your staff have the certificate of Six Sigma Green belt. It is excellent. Isn't it?

The QA said proudly: —Yes, some people have certificates relevant to quality management." I also have the "Black Belt".

He introduced me to the engineer who was the facilitator of the meeting. And he completed the special Six Sigma training course, earning a Green Belt certificate.

And he was trying to continue explaining about other certifications. But I stopped him and said: —It is excellent indeed. And? And why do you have such concerns about some quality issues?

—Mr. Kimura —QA confessed. I'm confused why it's of such poor quality. Why can't we reduce quality concerns from customers? Please let us listen to your point of view —He was very frank.

—Ha, ha, ha —I laughed respectfully—. Sorry, but I just looked at your factories. I don't know where the ***Genba-Ryoku***, your Organization and Management system, is…

—Therefore, it is not possible to comment. I will provide my Factory Checklist and recommend that you locate it on your own. The checklist is one kind of guideline for a sound factory. Please, check your factories by yourself.

With a slightly challenging attitude, Qfs intervened: —Mr. Kimura. I believe you are familiar with the Six Sigma perspective. We have obtained our Green Belt certificate, and we believe it is handy for improving quality. How do you think about that?

—Six Sigma? —I asked myself—. Hum. Firstly, let's confirm our understanding of it. My understanding is as follows:

> *This methodology aims to reduce the variability of business processes using statistical methods to improve the quality of products and services. It is based on statistics and uses data to improve processes. The goal of Six Sigma is to have 3.4 or fewer defects per 1 million process executions (6σ).*

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> *In addition to DMAIC, Six Sigma also has a method called DMADV (Define, Measure, Analyze, Design, Verify) for building new processes. DMADV is used when designing new processes rather than improving existing processes. This makes it possible to build high-quality processes based on customer needs. In particular, it is widely used as a method to improve customer satisfaction, focusing on the voice of the customer (VOC; Voice of customer).*
>
> *By Wikipedia*

—Yes —Qfs agreed—, your recognition is match to us. Do you have a Six Sigma certification?

—No, not at all —I admitted—. I just know it as common sense. Even so, I recognize you may be hard workers for improving quality with such a technique. But please, consider why you cannot achieve your target on your own. The problem might be different, or an unsuitable technique chosen, or no relation to such a technique. Anyway, please think for yourself.

—Do you intend to improve quality issues by Six Sigma? Is this technique suitable for your company? I don't know, but I have a slight doubt.

The QA was surprised: —Mr. Kimura. Why do you have a doubt? Do you doubt the effect of the Six Sigma approach? Customized instead of as-is

—No, it is not that way —I recognize—. But I doubt using it directly, and think you need to customize it to suit your company. My comment is very common to any company.

> *Six Sigma is a quality improvement method developed by Motorola in the United States, but there are some challenges when applying it to other countries and cultures.*
>
> ***My tweet***

—In the materials, it was "developed" by Motorola. But the word of "development" is not correct. And it is an application or customization of TQC quality improvement steps.

—I have some reasons to say so. One is the historical reason. DMAIC is a variation of the quality improvement steps in Total Quality Control (TQC). And another is implementation by project style.

—It can be said that Six Sigma is a project management system. It has a serious reason.

—US factories have the difficulty of the so-called "Bottom Up". I saw many US factories. And I could understand that US factories cannot or have difficulties in bringing up "All people's participation". Unfortunately, the “Bottom Up” culture cannot be brought up. Therefore, they employ the Top-Down style under a project management framework. Then, a company customized the part of TQC and named it “Six Sigma”.

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—DMAIC? There was nothing new about it. But it has one critical point. It is the application of modification, or in other words, it involves customizing an existing method or system, such as Six Sigma at Motorola.

DMAIC vs QC Story of TQC (From TQM-1)

DMAIC story:

1. *Define the problem,*
2. *Measurement,*
3. *Analysis,*
4. *Improvement and*
5. *Control*

QC Story of TQC:

1. *Deciding theme and target,*
2. *Reason of deciding theme,*
3. *Status Understanding and Analysis,*
4. *Pursuing causes,*
5. *Countermeasure and Implementation,*
6. *Confirming effects,*
7. *Standardization and Prevention of Reoccurrence,*
8. *Review and Confirming Problem remained,*
9. *Future plan,*

And please refer to TQM-3. Note about the Trap of Statistical Quality Control

TQM-1: Prologue and What is QC

TQM-3: Hardware, Software & Diagnosis

—For example, Cultural differences: Each country has a different culture and business practices, so it may be difficult to apply the principles of Six Sigma as they are. In particular, adjustments are required during implementation due to the varying styles of teamwork and communication.

—Education and training: Education of employees, especially education and training in project activities, is essential for the effective implementation of Six Sigma. However, the quality and content of education vary significantly from country to country, making it a challenge to design an appropriate training program.

—Leadership style: In American corporate culture, leadership is often emphasized. Anyway, problem solving is a project style, not the all people's participation style of TQM. This can sometimes make the implementation of Six Sigma less smooth.

—One excellent point of Motorola was to modify and customize one part of TQC to their corporate culture.

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—Even so, why do you contact me? I'm a professional of TQM, but not Six Sigma. Well? The difference of TQC and Six Sigma. In the first place, the feature of Six Sigma is to have a project style and top-down style.

—Please never misunderstand why we are having this dialogue. Through this dialogue, we are confirming the best way to resolve the quality issue.

With an evidently dissatisfied attitude, the Qfs mentioned: —Mr. Kimura. Probably, you may misunderstand the difference between TQC and Six Sigma —and he continued…

—Six Sigma is a top-down methodology, and projects are carried out based on instructions from management. We agree on this point. A key aspect of Six Sigma is its emphasis on quantitative analysis based on data. It aims to minimize process variability. Specifically, it utilizes the DMAIC methodology, which consists of Define, Measure, Analyze, Improve, and Control.

—Ha, ha, ha —I tried to release the tension—. TQC also has a top-down and project-based style. For instance, the QC-Circle activity of Total Quality Control (TQC). If a company-wide project for quality improvement, similar to your company's, is planned, QC Circle activities of the ***Kaizen Genba Committee*** are also involved, and a special theme is requested from top to bottom.

—TQM has both sides: Top-Down, and Bottom-up. Also, it is based on statistical quality control.

—Six Sigma? DMAIC? OK, OK. And? —I asked them when I tried to dive deep into my thinking—. There are the success stories of Motorola and other companies. However, when adopting a method such as Six Sigma, it is essential to consider the cultural context of countries and corporations. Is your corporate culture similar to Motorola's? How about the strategy and policy control? What are the characteristics of Gemba people, and what is ***Genba-Ryoku***? How about the people turnover ratio? What about the situation with people's engagement? What is your organization's and your management style? Anyway, other people's success stories will not be able to replace your success story.

—Once again, the excellent point of Motorola was to modify or customize the statistical quality control method to its company against its corporate culture and situation.

—Continuous effort leads to strength.

—By the way, you implemented a quality improvement project 3 years ago, did you? According to the quality status trend report, good results were reported at the project's beginning. However, it couldn’t be continued, right? hy? Why couldn’t you?

—Mmm, mmm —QA could not respond at first—. It is my concern that our production department cannot keep up with or develop the situation.

—Yes —I agreed—. Even if you made a good activity, if the ***Production-Genba*** or your management capacity cannot keep and continue it, there is no meaning.

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—Did you discuss or have a dialogue with your Genba? As the ***Production-Genba*** and your ***Office-Genba***, what were you saying about Six-Sigma? …

—You said that production Gemba cannot keep its quality status, right? What do you think what is the lack?

—We believe we are providing sufficient support to the production site —Qfs proudly mentioned.

—There are 2 facts: You succeeded in improving the quality situation once. But it couldn't be kept by the production Department. Right? —I asked them and continued…

—Everyone, the key step of Six Sigma is DMAIC. The last process is "C" and it is Control. Is it right? You are professionals in Six Sigma. So, what are the contents of the Control?

With a disgusted look, the QFs intervened: —There are three contents: Standardization, Monitoring by KPIs, and Training. We have a specific program for them.

—I don't deny Six Sigma and DMAIC process —I admitted—. But you couldn't deploy it. Why cannot ***Production-Genba*** deploy and maintain it?

The Qfs answered: —This is our concern area; why can't they?

After a while thinking, I answered, trying to add value to the conversation: —Don't you think it is not sufficient C of Control? Standardize, monitor by KPIs, provide feedback, and implement a Training system. You are doing these. But, the situation is continuing to worsen. For instance, Heinrich's Law is also about quality.

—Customer's quality complaints. It seems to be a little increasing and the same situation as before the Six Sigma project. And it can be called as a critical quality accident. It is one kind of accident. Right?

—Once again, I never deny the Six Sigma approach. But it has some faults. These faults are not common to all companies. Probably I'm right. You need to tailor Six Sigma to your company's specific needs and circumstances. Then, I say it is necessary to customize Six Sigma for your company.

—Could be you are right —QA admitted—. And Mr. Kimura. What do you think the faults are?

—I don't know. Please find it by yourself —I answered—. What is the lacks of your "C" of Control? Therefore, I recommend using my Factory Management Checklist. You know, approximately, I understand that your factory cannot maintain or improve quality, even though you insist on Six Sigma.

QA showed doubts in his face: —Mr. Kimura. Please let me know what your points are.

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—Because you know what —I tried to explain some fundamental concepts about a manager's mind requirement—. When we took a factory tour, I saw a toilet with a bad smell, a dirty scrap can filled with rubbish, and a messy backyard—quite a bad 5Ss situation. You may misunderstand the 5Ss. It is not just a mere beautification of passages. Beautification is just one element of the 5Ss. Your factory passage is clean. But a bad 5S condition. It is like a cut-corner 5Ss…

—Quality improvement? Ridiculous. There is no reason to be able to keep and improve quality.

—Bad 5Ss shows several weak points of your factory. It is not only the direct influence on

quality, but it also shows the poor ***Genba-Ryoku*** (Gemba Ability).

—No, no, no —the Qfs denied energetically—. We disagree with you. We think our production site is controlling well. Keeping the production plan, keeping KPIs data collection. We are making regular quality meetings involving the factory. Of course, we are discussing countermeasures of customers' quality claims and the level of process defect ratios.

—We think we are doing the necessary control of Six Sigma —the Qfs concluded proudly.

—I also thought so —QA admitted—. However, the current results indicate that something is amiss. I need to find what is wrong. Please advise what is wrong in Control.

—I don't know, what could go wrong —I confessed—. Therefore, I recommend that you go back to the originals. Finding what is wrong is not difficult and doesn't take much time. Please check your factory with the Factory Checklist and the 5Ss checklist. Of course, I recommend that you customize or modify my Checklists for your company.

In a whisper, the Qfs concluded: —Therefore, Mr. QA, as I told you, it has no meaning to invite a consultant who is just selling his consulting material.

I have to say he was right: —Ha, ha, ha. Mr. QA, it is not necessary to contract with me —and I continued…

—Factory Management Checklists? I give these for free. Please check what was wrong and what is the correct way for your factory.

—But still, you are hard-headed (Thick-Headed). Why do you insist on Six Sigma? Is its approach suitable for your country and your corporate culture? …You need to think more —I concluded.

Factory Management Checklist V.2023

—Mr. Kimura —QA honestly insisted—. You are a little rude, aren't you? We are thinking, thinking and thinking very seriously. Plural Perspective Thinking: Please

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consider things from multiple perspectives. KPI numbers, what do they represent?

—Ha, ha, ha —I laughed—. Sorry, but did you think not only in 2 dimensions, but also in plural dimensions?

—??? What do you mean? —questioned Qfs, just a little lost in the conversation.

—Your why, why and why. It is only 2-dimensional thinking —I explained—. Did you dare to think about it from a different perspective?

—Logical thinking. It is important. But I think a person's logical thinking has only 2 pitfalls. For instance, the system based on statistical data has a weak point.

—Please listen —I dive deep just a little—. A phenomenon has many facts. To illustrate the point, I often tell the story of the elephant and the three blind men. If it touches the tail, it is like a small snake; if it touches the leg, it is like an enormous pillar; and if it touches the body, it is like a wall…

—If changes the perspective, there are different perspectives, of course, with different numbers. There is a quality concern. The statistical data, particularly customer quality claims, support this finding. The statistical data show the trend in the quality situation. But your statistical data has a severe limitation. Statistical data cannot reveal the causes of quality concerns, but rather only one aspect of the phenomenon…

—It is to think about something from only one side. You are considering the situation from statistical data. It is good. However, one statistical data point reveals only one side…

—A thing has many facts from many sides. And often, there are cases where the statistical data is not representative…

—Once again, of course, statistical data is very much important. But you need to have other essential conditions. It is Creative Thinking Capacity (Insight, Divergent Thinking, Convergent Thinking, Lateral Thinking, Analogical Thinking).

—Can your company do Six Sigma? —I asked them, but I continued without waiting for the answer.

—Sometimes I do another story, which is the movie "Planet of the Apes". There is one scene in which the members of a crew of astronauts suffered an Advanced Brain Surgery to eliminate their intelligence…

—On the other hand, the ape soldiers ride horses and bring rifles. There is a significant gap in the structure of civilization. Such a low civilization cannot have the technique of advanced brain surgery. Could I get your good understanding? —I asked them finally.

Both Qfs and QA doubted that the tale's aim was linked with the target of the meeting: —Mumm.

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—OK, I understand —I admitted—. I'll introduce you to another story, which is my unsuccessful story: A company asked me to introduce the ***Kanban*** System in their company. And, as per his request, I introduced it in a single model line. And the introduction of the single model line was successful. However, after one year, the model line had disappeared. His aim of TPS introduction had failed. The reason is now quite apparent, and it was due to the low factory management capacity of this company. It wasn't sufficient capacity to adopt the ***Kanban*** System…

—Six Sigma? —I asked them to link the reasoning with the previous tale—. Good. But have sufficient factory management capacity to implement it? —I asked them and I answered myself.

—I don't know if it is suitable for you or not. It is quite a natural question to have a certain essential base for Six Sigma, such as a high-level technique. However, and actually, it is not a high-level technique.

—However, the most relevant issue may be your Creative Thinking Capacity— creativity and pitfalls in the Statistical Numbers. I'm very sorry to say that you fault your Creative Thinking Capacity.

Creative Thinking Capacity

—Mmm... What do you mean Mr. Kimura? —QA asked, just a little bit lost in the conversation.

—Let's see, well… —I tried to search a clear example in my brain for a while—. For instance, we had a conversation about the 5 Whys.

—Okay, the 5 Whys: I like this thought. I prefer this though. However, it is not a good technique for resolving quality problems.

For instance, the following is one example of 5Whys deployment (From TQM-8).

TQM-8: The arrow diagram

—What!? Do you deny it? —Qfs questioned.

—Yes, I do —I answer securelly.

—Crazy! —Qfs questioned depreciatively.

—Just because this technique pursues resolving the problem in only one category. A problem has many underlying problems. I like Fish Bone, which I have already explained.

—Let me explain from another perspective. I think you're familiar with Heinrich's Law, aren't you? —I questioned them—. Yes, according to this theory, 300 near misses precede a serious accident. It is a very famous theory, isn't it? The Heinrich's law, yes.

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—Heinrich's Law is a theory in industrial safety that suggests a relationship between the frequency of accidents and their severity. Developed by Herbert William Heinrich in the 1930s, the law states that for every **one serious accident**, there are **29 minor accidents** and **300 near misses or unsafe acts**. This is often represented as a **1:29:300 ratio**.

—Whether this rule applies in reality depends on the situation. In some industries and work environments, this ratio will not apply. Also, there is no simple relationship between "more minor accidents and more serious accidents."

Zero accidents - LinkedIn publication extract about Hiyari-Hatto Report. An example of an HH report and a list of HH examples.

—For example, in high-altitude work, "one mistake = immediate fatal accident," and 300 near-misses do not necessarily result in minor injuries. Additionally, there is a bias in the reporting of Hiyari-Hatto[1].

—In actual workplaces, "near-misses" are not easily reported. If these are not adequately documented, the 1:29:300 ratio is out of line with reality.

—I know, I know —I confessed—. Quality problems and human accidents are different. However, I think that the concept of 1:29:300 is adaptable to the quality problem. And Serious Accident can be replaced with Customer's quality claim or in-house serious quality concerns. 29 quality problems have 300 production Gemba problems in behind. Of course, these numbers are mere metaphors. But please understand there are some faults in your Control (of DMAIC) capacity.

5-Whys (From TQM-8)

This is my failure or shameful case. If possible, please ignore this Note.

We (You) are too clumsy to think deeply. For instance, 5 Whys is a very famous phrase. However, I haven't seen the success of 5Whys analysis and/or Fishbone diagram in the world.

In the textbook, there is an example of Toyota as follows:

2. *Why overload? ➔ Insufficient spindle oil.*
3. *Why lack of oil? ➔ Insufficient pumping of oil (worn pump shaft)*
4. *Why does the pump shaft wear out? ➔ Chips were mixed in.*
5. *Why are chips mixed in? ➔ Filter damaged.*

If you dig deep enough, you'll find the root cause of the problem. Therefore, if you install and maintain a filter in the oil circulation system, you can permanently resolve the issue of the machine stopping frequently. This is Taiichi Ohno's scientific analysis based on facts.

[1] Hiyari-Hatto report LinkedIn publication: https://www.linkedin.com/pulse/total-preventive-safety-eduardo-l-garcia/?trackingId=rxgjUV9ATESO2aba6VLFOA%3D%3D

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Additionally, various formats are introduced in SNS. However, I haven't seen a true 5-Whys analysis in the actual Gemba.

--- Omit---

—Once again —I insisted—. Based on Creative Thinking, statistical data can be essential for factory management.

Actually, discussing the weaknesses of statistical data, I have already written about that in Factory Management-3:

TQM-3: TQM Hardware, Software & Diagnosis

Weak point of Statistical data.

…In TQM, I emphasize the importance of QRQC (Quick Response Quality Control).

The concept of QRQC is to find the solution in "To visit the Gemba and to Look at the Truth immediately (very fresh data)".

Conventional QC (Quality Control) is based on the collection of statistical data, as taught by Dr. Deming. However, the system based on statistical data has a weak point.

Statistical data is required to categorize, as there are numerous varieties of phenomena.

For instance, a defect or a crack in the workpiece. The phenomenon is "crack". But the assumptions causes are so many, or still unknown. And it is not realistic to take action on all assumptions.

Then, in QC, it is recommended to gather data as much as possible under categorized (and minimized) assumptions.

But unfortunately, the probability is:

- *The phenomenon: A Crack in the workpiece.*
- *Assumption categorized: Deformation of the parts.*
- *Analysis in Fish-Bone (including 5Why): Deformation of the parts by pressure in the previous process, or deformation by the process, or parts material defect, or…*

And anyway, it is required to take action on the assumption. It is not bad. But unfortunately, the solution is also supported still by an assumption.

I thought that nobody could see the true causes because nobody has a time machine to go back to the past to see, like the old movie "Go Back to the Future".

Therefore, I taught and recommend QRQC to get very fresh data to close to the truth.

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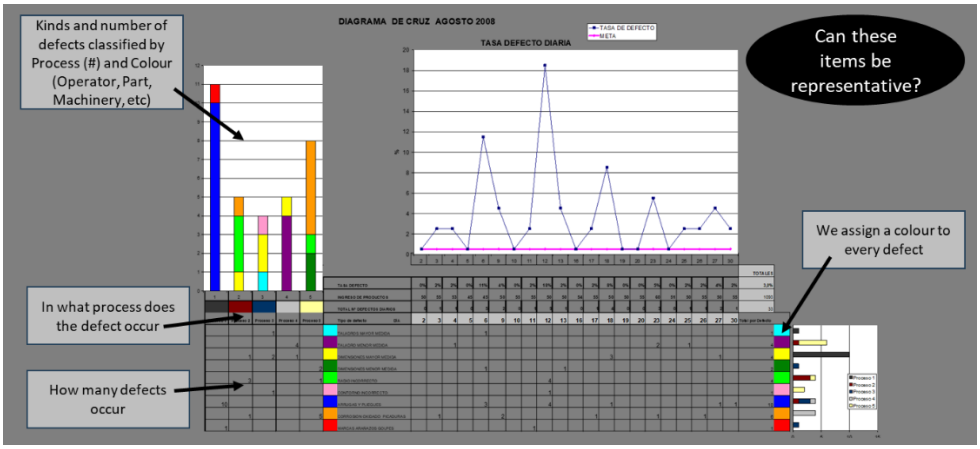
However, it is now possible to see the truth in IoT in real-time. By installing inexpensive sensors in the machine and processes, it is possible to gather the necessary data. If you like, it's a good idea to put a video in the main machine and process, so you can see the trouble caused. When the sensor detects an abnormality, the video image before and after the 5-minute period is automatically stored.

"So, QC approach is also changing".

—What??? I don't understand —the Qfs mentioned, just a little confused.

Then, I tried to delve deeper into my thinking: —For instance, the following graph. It is a Cross graph.


Kinds and number of defects classified by Process (#) and Colour (Operator, Part, Machinery, etc)
DIAGRAMA DE CRUZ AGOSTO 2008
TASA DEFECTO DIARIA
Can these items be representative?
We assign a colour to every defect
In what process does the defect occur
How many defects occur

—This is my example. There are items with defects categorized by colour codes. You also have your process quality control chart with defect categories and a graph. Here, the aspect you need to pay attention to is that the categories represent similar defects. Therefore, the graph doesn't show the total facts.

—Understood? —I asked them.

—Mmmm —The Qfs muttered.

—OK —I admitted that probably, it was not clear enough to them—. Another example. A park has a swimming pool.

The Qfs continued incredulously: —Swimming pool?

—Yes, swimming pool. Please listen —I requested them—. When checking water quality, your country also uses the E. coli test method. E. coli is easier to find than other germs. The number of E. coli is one of the key indicators. The number of E. coli bacteria present can indicate the safety of the water.

—Your process quality control graphs —I continued—. You need to understand that your defect categories and the figures are the "trend" and a barometer…

—Of course, it is essential to keep such a control graph. However, please approach it with more creative thinking.

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—I see… —the Qfs admitted—. The category of Dimensional defect indeed consolidates various similar defective items. Mumm... E. coli is the barometer. And the number of germs is the detail of dimensional defects. I can see it.

—And your quality trends… —I continued—. When examining the quality data, the most prevalent defect item is the Dimensional defect, followed by colour unevenness. Probably, when writing a Pareto Chart, these are the top two items that require action. Right? …

—But this dimensional defect is one of the representative values and items. I think the representative dimensional defect is not a single phenomenon, but rather a variety of dimensional defects. Right? And, these should be different causes depending on the location or circumstances. The colour unevenness defect is also the same. Depending on the product's location, the condition of the defect that occurred is different…

—And if increasing the defect category, the graph becomes complicated. Moreover, so far, you may not have identified any other defective items…

—Statistical data... Of course, it is essential. However, when examining it, you need to adopt more flexible perspectives. It is a general theory; I dare say it the next: There are several possible reasons why quality has not improved despite the use of quality control methods in manufacturing companies…

—First, a significant factor is a lack of manpower and the assigning of work to a specific person. Insufficient manpower may result in inadequate resources, and quality control measures may not be appropriately implemented. Additionally, if operations are dependent on a particular individual, quality control may cease to function in their absence…

—Secondly, a lack of cooperation between departments is also a problem. If different departments in the manufacturing process do not cooperate with each other, it becomes difficult to share information and identify issues early. This can lead to quality problems going unchecked…

—In some cases, quality control methods have become a formality. Activities often become merely routine, and no substantive improvements are achieved. Activities often become formalized and do not lead to actual problem-solving.

—Thirdly, as you pointed out, lack of education and training can also have an impact. If workers lack the proper skills, human error is more likely to occur, and the quality of the work will be adversely affected. Inadequate training programs can prevent workers from developing their skills, resulting in subpar quality.

—Finally, employee satisfaction. If you do not try to foster this, quality will become someone else's problem for your employees.

—Ha, ha, ha! —I tried to release the tension—. These are just chattering. Please understand that my point is that when attacking and pursuing a solution, it is essential to have some multi-dimensional perspectives.

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—Six Sigma? …It is good. However, if your Six Sigma is just based on statistical data, you may also have pitfalls.

C of DMAIC (Control)

The QA showed some kind of understanding face: —Variety of perspectives. Humm… I understood. I also think it is essential.

—Still, we cannot find our solution, I believe —the Qfs mentioned—. We are doing a variety of perspectives. For instance, when we planned the implementation of Six Sigma, we created a project that involved several departments and also representatives from the production site.

The Qfs proudly mentioned: —Therefore, I think there is no fault of the variety of perspectives.

—I see, it was good —I agreed—. And, you are the team leader, Mr. Green Belt. Aren't you? —and I continued without hesitation—. By the way, there is a world map on the wall. Have you looked at a map upside down?

—What? …Of course, not. Why is it necessary? —the Qfs asked me, surprised.

—Looking at a map upside down can bring a new perspective to our thinking and perception. Usually, maps are arranged with north on top, but turning them upside down requires a different spatial perception than usual. Such a visual change may stimulate the brain to think more flexibly, improve creativity, and break down stereotypes.

—Why Six Sigma? — I asked them to come back to the central theme—. Once again, you have succeeded in improving the quality situation. However, soon the situation changed. One of the causes imagined is the C of DMAIC. I think C should be the C of Continuation and not Control.

—Continuity is a very important capacity for a company. In Japan, there is a proverb: 継続は力なり: Keizoku wa chikaranari.

- 継続: Continuation.
- 力: Force or Capacity.

—**Must you be able to continue**, for instance, **a policy** or a thought. This is a critical ability for a company. It is not just a matter of continuing, but also of being flexible and adaptable. And "make sure that continuing does not become an objective. (Change what no longer fits with the times and the external environment)

—I don't know your company yet, but I could imagine your weak points from the factory tour and some quality reports.

Quality sensitivity

In my heart. It's really hopeless, isn't it? And I whispered: —This Brontosaurus company is.

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—Qfs; What??? Brontosaurus company? —The Qfs asked, thinking it was something lost in translation—. What is the mean?

—Ha, ha, ha —I tried to accommodate my speech—. Never mind, please.

—But I'm curious. What is the mean? —he insisted.

—Well… —I hesitate in the meantime; I was searching for a simile in my mind—. Have you watched the movie Jurassic Park? In this movie, a long-necked dinosaur, known as a Brontosaurus, appears.

—This dinosaur is very insensitive, and when he is bitten on his tail, it takes about 6 seconds to transfer to his brain —well, indeed I thought it was an exaggeration, when in reality it is about 0.3 seconds, when for a human it takes 0.03 seconds. However, the simile was appropriate from my perspective.

—Mr. QA. Your company appears to be insensitive to quality issues.

With a bitter face, the QA requested clarification: —What is the meaning Mr. Kimura?

—I'm telling you that you are very much insensitive —I insisted.

—How rude! —The Qfs pointed out—. We are sensitive regarding quality concerns. You say we are Rude!

—OK, ok, ok —I tried to release the tension—. Mr. QA, how much inventory do you have in the warehouse? Because I saw a scene of re-inspection by QA people. Did you receive a customer quality claim regarding products shipped from inventory?

Again, with a bitter face and just a little bit anxious, Mr. QA answered: —Yes, indeed.

—We had a quick response to resolve the customer's concern —The Qfs clarified—. Also, soon, we feed back to the production line. Why do you say we are "Insensitive"?

Whispered but audibly, I answered: —It's a helpless company, he is.

—Please listen, Messrs. Qfs. When, where, what time, how and by whom, and also in what condition that product was produced? Is it possible to reproduce the same condition? And I pointed out that the same condition means that considering the same environment: Air pressure, electricity, weather, condition of lubricant, machine speed, operator, material, condition of material, etc.

—Listen, it is essential to have statistical data. I never deny the Six Sigma approach. But it is never sufficient or has a fault. Almost, we cannot look at and find the true causes from the facts. Therefore, it is essential to see the Gemba immediately when a quality problem occurs, as Toyota does. You must also have the capacity for flexible thinking.

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—Mr. QA. How much inventory do you have? — I requested the data again.

—Mumm —he hesitated for a while—. About 3 to 4 months.

—Do you think that, for instance, an inventory has no relation to quality matters? —Without needing an answer, I continued—. Now you are producing. And what is the timing of the inspection? What is the timing of feedback of quality concerns? It seems to take half to one day. How can you find the facts when quality concerns occurred?

Again, I did not wait for an answer: —Backing to the Six Sigma issue and C of DMAIC. Probably, you have a necessary corporate capacity issue. A fact is that you have a lack of Continuation Capacity. And, another point is that a defect has many faces. One fault has many faces.

—Another perspective —I dive deep into my thinking—. For instance, one of the facts in one defect category has been resolved. One defect category, for instance, is a dimensional defect. Then, one part of the defect was resolved. But another part of the dimensional defect could remain. I don't know but such causes are also imaginable.

—Listen please —I insisted—. The defect category of statistical data is the same. One category doesn't always have one defect content and the cause; they usually have several contents and causes. So, just because one cause has been addressed does not mean that this defect category has been resolved…

—For instance, FMEA. In this example, we can identify three causes for a single defect mode. I'm telling you that even if one cause is resolved, it is not the same as resolving a defect category.

#	Process Indetification	Month	Sales	Finance Administration	Enginnering Design	Production engineering	Human Resources	Planning and Production Planning	Quality and Inspection	Purchasing and Warehousing
1	***Design-1***	-24	Research and Need Analysis	Cost Plan	Need Research and Analysis	Proprietary research				Raw material research and purchasing needs
			Design Concept		Design Concept	New technology research				
			Competitor Research		Competitor Research					
					Design Idea			Production Plan	Examination of Manufacturing Drawings	
					Raw Material Information					
2	***Essay***	-19	Evaluation and Concept	Cost Analysis and Tentative Cost Target	Evaluation and confirmation of the concept	Trial production		Trial production	Organize the Quality Committee in the initial period	New Raw Material Research

Fish-Bone rather than FMEA.

I don't like FMEA. Of course, it is possible to increase the number of defect modes and causes if there are, and we can assume more and more.

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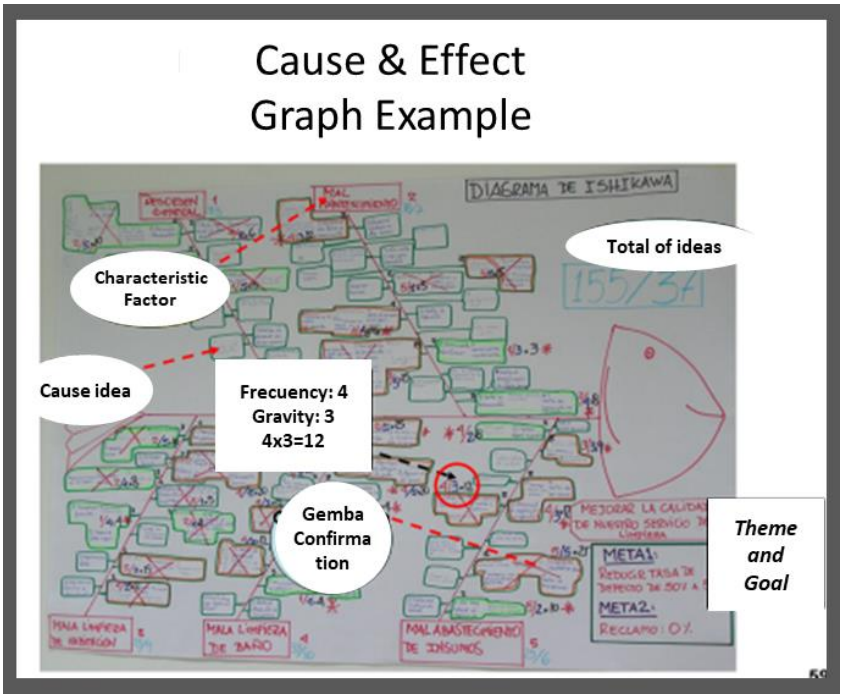
However, I haven't seen such a large FMEA deployment so far.

It is challenging to identify a defect that has multiple faces. Above all, solving defects requires a creative orientation, but FMEA makes it challenging to demonstrate this. That is why it is KJ.



Additionally, one defect category should encompass several other related facts (defect categories) that are summarized in a single event.

The Qfs died to replicate: —But, as I talked before, we succeeded while made the project activity. However, as you said, we might have a lack of continuation capacity. And we put in effort to this point through the Six Sigma project activity.

Six Sigma by a large-scale company – Action plan paper

—Six Sigma? —and as usual, I answer myself, just because it was only a rhetorical question—. It is a total quality innovative system involving the C of DMAIC. I think if there is a limit, it is the wall of … Well —I would rather not delve deeper into more examples—, the most important thing is to establish and keep a **Companywide Kaizen system**.

—Kaizen and Companywide Kaizen? Innovation? —I repeated and explained each one: Kaizen is about gradually improving the current situation and systems while utilizing existing frameworks. And, Innovation means making a significant change to the current situation or system. It often involves radical and large-scale change, and in some cases, it entails dismantling the existing framework and constructing a new system.

—You succeeded in the activity of Six Sigma, excluding the C of DMAIC. Now the effects of Six Sigma have disappeared. It indicates that you lacked a fundamental foundation for Six Sigma implementation. You may have read the success stories

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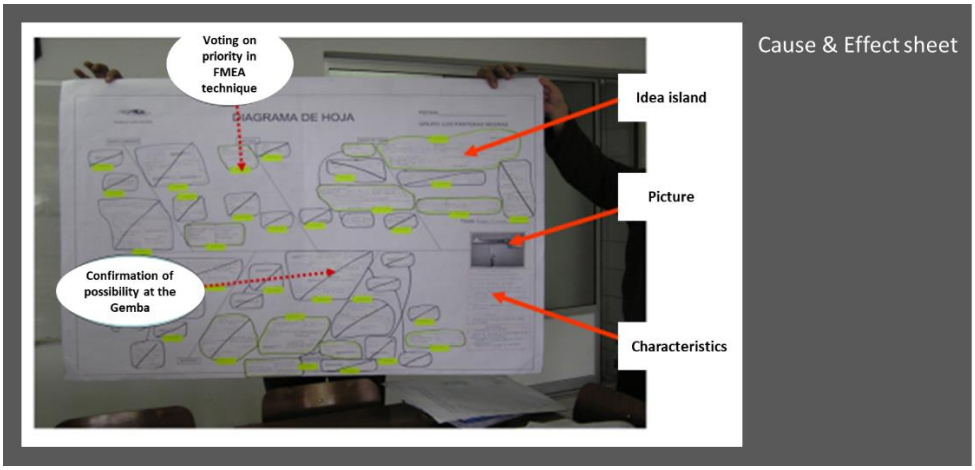
of other companies. However, the success stories are examples of large companies that have essentially the necessary capacity to implement project activities and adopt them.

—Probably, you have no base yet. You know what? —Again, I asked rhetorically— a project activity is a temporal activity. And you needed to make up a new corporate culture…

—By the way, I don't recommend, for instance, FMEA, which cannot consider from so many sides (Logically, it is possible, but it is not suitable.). For example, the following is a Fishbone Diagram (created by Gemba operators). It is possible to consider a defect from multiple perspectives. Thus, a Fish-Bone diagram is a collection of 5 Whys.



—At that group, we were challenged to resolve the quality problem of the main product. They considered the causes by 4Ms (Man, Machine, Material, and Method). It is good, because thinking is defective from some different points of view. But if they were feeling from more different perspectives, it is better.

—You are insisting on Six Sigma. However, it appears that the control process is not progressing well.

—By the way, I quickly looked at your (old) project's action plan (by Six Sigma). This action has the following items: (1) Purpose and targets. (2) Project organization. (3) Review system. (4) Action items by DMAIC. It is good, isn't it?

—I think so —QA agreed—. I believe the steps of action planning and implementation were correct. However, unfortunately, I must accept that our quality capacity has not improved or, more seriously, has deteriorated. Therefore, I wanted your advice from your outside perspective —QA finally requested me.

—I also believe our activity was correct and effective —The Qfs concluded.

Even though Mr. QA restrained them with his hand and asked me my opinion:

—Ha, ha, ha! —I laughed—. Please relax and let's continue this dialogue. Msr. Qfs, you're putting too much force into your shoulders.

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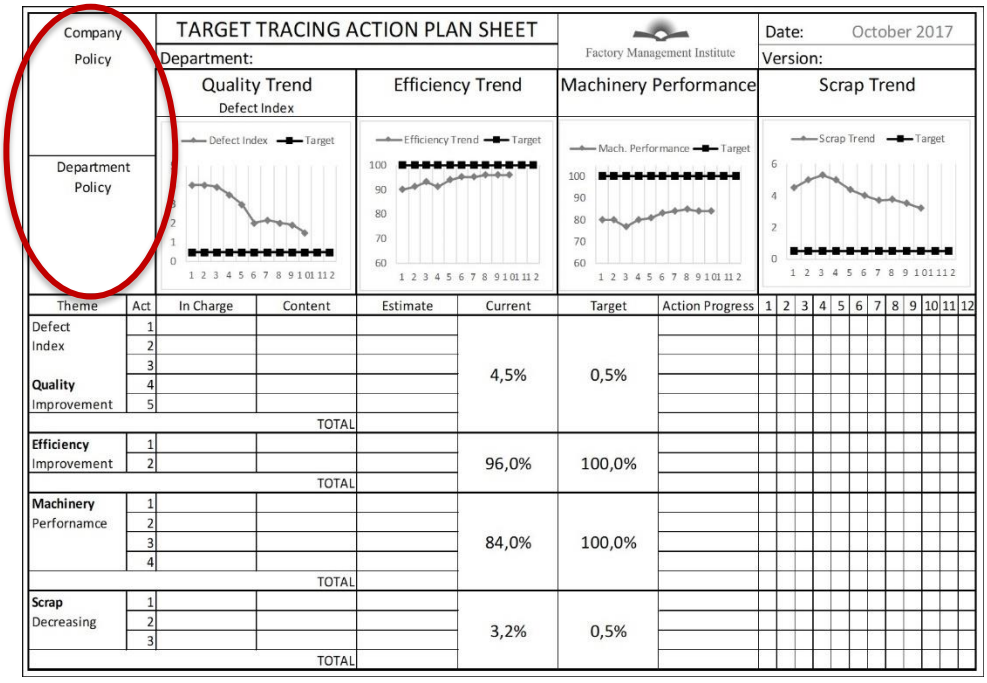
—Once again, the steps of a quality improvement project are the same in any case, even Six Sigma: D of DMAIC; Analysis of Current situation, Define problems. M; Again, Measuring and Analysis. I; Implementation of action items and improvement. And, C; Evaluation and PDCA cycle.

—Your action plan seems to have the steps. It is very sorry for my rudeness, but your action plan would receive a 0-point evaluation from my previous company (Sumitomo Wiring Systems).

—What!? zero evaluation!? —QA surprisingly asked—. We successfully improved quality, even in the short term. But a zero evaluation. Mmmmmmm… —He muttered with displeasure.

—Yes —I confirmed—. Sorry, but it is true. “Succeeded in improving quality, even in the short term”? …I call this phenomenon "Festival effect". It is pretty natural that implementing a company-wide activity will have a positive effect. It is like a festival.

—Anyway, it is not acceptable if the action paper doesn't have the corporate annual policy (about quality) like in the paper marked by a circle. And when it is submitted, it is rejected immediately due to a lack of policy.



Theme	Act	In Charge	Content	Estimate	Current	Target	Action Progress	1	2	3	4	5	6	7	8	9	10	11	12
Defect Index	1				4,5%	0,5%													
	2																		
	3																		
Quality Improvement	4																		
	5																		
			TOTAL																
Efficiency Improvement	1				96,0%	100,0%													
	2																		
			TOTAL																
Machinery Performamce	1				84,0%	100,0%													
	2																		
	3																		
	4																		
			TOTAL																
Scrap Decreasing	1				3,2%	0,5%													
	2																		
	3																		
			TOTAL																

—And next are the must-have items in the project action plan paper:

1) Annual corporate policy (about quality). When making an action plan, it is pretty natural to identify the corporate policy in the left and upper corners.
2) The concrete target in the Annual Policy. Number of customers' quality claims. Defect (products) ratio in process. Total defect ratio in the process.

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a. *Defect (products) ratio = (No. of defect products / No. of products) x 100.*
b. *Total defect ratio = (No. of defect occurrences / No. of products) x 100*
For example, 100 products are produced. Additionally, 5 defective products were identified during inspection.
Defect ratio = 5%.
However, if those 5 defective products had 3 defect points in each product, there would be a total of 15 defect points.
So 5%x3dp = 15%;
Total defect ratio = 15%.

From TQM-7 - ← QR

3) Quality Cost in Disposal, Repair, and Claim Treatment.
4) Others are similar to your action plan paper. Then, omit to describe.

—But probably, you may have a critical fault in your plan. How do you think?

The QA admitted: —I cannot reach an answer. Did we have the faults of the survey and analysis? My project team successfully resolved the quality issues in accordance with the action plan. But we couldn't keep the results. Maybe the quality background was changed? —and he continued without waiting for an unnecessary answer.

Companywide activity

—Oh —I exclaimed—. It may be one of the good points. Let's continue this discussion for a bit. So, Survey and Analysis. What did you do for these?

—We surveyed, analyzed and measured the current status of production probably sufficiently —The Qfs mentioned.

—It was good —IK admitted—. So, what was wrong? Sorry, the word "wrong". Again, so what were the faults? Survey, analyze, and measure. These were implemented sufficiently. If so, what was the fault? —I asked them.

With an attitude of a little hesitation, the Qfs finally answered: —Is the fault the range of survey and analysis? …Mmmm… Our target was just the production site.

The QA intervened: —One of the answers is the following: Quality and production. It is not just a matter of the production site, but all departments, for instance, top management, the administrative department, and even indirect departments, such as engineering, production, and maintenance, should be the objectives and involved in the survey and analysis.

—For instance, the Sales department —The QA finally detailed.

The Qfs confirmed: —Sales department... We involved this department to gather the customers' voices. But changing market?

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—Ha, ha, ha —I laughed—. Very good. I suppose that your Six Sigma activity might not be a company-wide initiative. And I asked them: —Were there new product introductions in these 3 years?

—Yes, there were —The Qfs confirmed.

—If so —I questioned—, how was the relation, for instance, between the Sales department and Engineering? —and I continued—. What about the system for introducing new products? Do you have a particular system for introducing new products? For instance, IPQC (Initial Product Quality Control).

And I detailed: —When a new product starts, I organize this project. And this project involves all departments, of course, including administrative departments. This project is for quality, but involves all departments. Because production and quality are not the matter of just the factory, but all departments.

—However… —I hesitated—, I have a question: What are the exam items of the Six Sigma Green Belt Certificate?

Then diligently, the Qfs detailed: These are as next… —I didn't record it. And the following is an extract from a Six Sigma site in in SNS.

Six Sigma Examination Skill.

…Fom SNS about Six Sigma

Six Sigma Green Belt Certification Exam Skills Evaluation:

Six Sigma Green Belt certification exams evaluate a range of skills that are essential for effective problem-solving and process improvement within an organization. Here are the key skills typically assessed:

1. Problem-Solving Techniques

Green Belts must demonstrate a thorough understanding of various problem-solving methodologies, including defining the problem, analyzing data, and implementing solutions. This involves applying tools like DMAIC (Define, Measure, Analyze, Improve, Control) effectively.

2. Statistical Analysis

Proficiency in statistical methods is crucial for analyzing process data. Green Belts are expected to use descriptive statistics, control charts, and hypothesis testing to understand data variation and its impact on process performance.

3. Project Management Skills

Candidates should possess the ability to manage projects efficiently. This includes planning, executing, and monitoring projects to ensure they are completed successfully within defined timeframes and budgets.

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4. Quality Control Techniques

Understanding quality control principles and tools is essential. Green Belts need to apply techniques such as Lean principles, cause-and-effect diagrams, and failure mode and effects analysis (FMEA) to enhance process quality.

5. Teamwork and Leadership

Effective team dynamics are crucial for project success. Green Belts are evaluated on their ability to lead teams, facilitate discussions, and drive consensus among stakeholders in process improvement initiatives.

6. Change Management

An understanding of how to manage organizational change is essential. This includes skills in communicating changes and training team members on new processes and tools introduced as part of the improvement projects.

7. Continuous Improvement Mindset

Finally, a commitment to ongoing improvement and understanding of how to incorporate feedback into processes is key. This reflects a proactive approach to quality management and operational excellence.

These skills not only ensure that candidates are well-prepared for the challenges they will face as Green Belts but also contribute significantly to the overall quality and performance of their organizations38.

Adding to the previously mentioned skills, several additional competencies are crucial for candidates pursuing Six Sigma Green Belt certification.

8. Leadership Skills

Green Belts should possess strong leadership qualities that go beyond teamwork. This includes motivating team members, resolving conflicts, and ensuring that all stakeholders are aligned towards project goals. Successful leaders also demonstrate the ability to influence and inspire change across the organization.

9. Organizational Skills

Organizational skills are vital as Green Belts often juggle multiple projects and tasks simultaneously. This includes prioritizing work, managing timelines, and effectively allocating resources to manage productivity and deadlines.

10. Knowledge of Six Sigma Tools and Techniques

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Candidates are expected to have a good grasp of Six Sigma tools such as Process Mapping, Root Cause Analysis, and Control Plans, alongside advanced tools like Statistical Process Control (SPC) and Design of Experiments (DOE). This ensures that they can implement and sustain quality improvements effectively.

By evaluating these skills, the certification process ensures that Green Belts are equipped to contribute meaningfully to their organizations, enhancing both efficiency and effectiveness through informed decision-making and strategic implementation of improvement processes.

In addition, I listed up the exam aspects of Black Belt also:

Six Sigma Black Belt Certification Testing:

Examination Format: Open book format, Real business cases; 3 hours duration, Approximately 150 questions, Multiple choice:

1. *Basic concept: Purpose and definition, History, DMAIC Model*
2. *Project Management: Project plan, Implementation and monitoring, Knowledge of methodologies and tools, Team leadership.*
3. *Data Analysis: Analysis of Variance (ANOVA), Regression Analysis, Correlation Analysis, Understanding of statistical techniques*
4. *Process control: SPC (Statistical Process Control), Use of control chart*
5. *DMAIC Process: Define, Measure, Analize, Improve, Control*
6. *Quality Management Methodology: Fishbone Diagram, Pareto Chart, Histogram, Control Chart*
7. *Human Factors: Member Roles, Communication, Team Leadership*
8. *Lean Methodology and Integration: Understanding of Lean manufacturing methods*
9. *Process Improvement Methodology: Root cause analysis, Optimization Methodology*
10. *Cost management and business strategy: Ability to calculate ROI, Understanding of financial aspects*
11. *Six Sigma Culture: Leadership skills, Facilitation of implementation*
12. *Required Skills: Theoretical and practical experience, Ability to lead projects*
13. *Expectations of the firm: Increased efficiency, Increased Customer Satisfaction*

After the presentation of the Qfs, not as extensive as the previous one, I called both the Qfs and QA's attention: —Now, everyone. I said that Six Sigma is based on a certain level of factory management (corporate management). If there is no established level of management capacity, it is not possible to demonstrate, even though you implemented it with considerable effort.

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—Six Sigma? Why? —and I answered myself before any other intervention.
—Why did you insist on it, even though you don't have a certain level of factory management capacity? If you deny my words, please show me with current facts. Six Sigma in a poor 5S condition? …There is no reason you can do it. ..

—Six Sigma in very low-level Inventory Turnover? There is no reason to be able to do it —and I continued…

—If you have the opinion that factory management capacity improvement by the opportunity of the Six Sigma project, it is very much acceptable. If so, you need to include the plan in your action plan paper and implement a company-wide activity that involves all departments, including Accounting, Sales, HR, and Administrative.

—Six Sigma is not an effective tool for your company. Perhaps you can understand that I've rambled on and on; the purpose of this dialogue is to find the right and suitable way for your company. And we could have a good conversation about your quality improvement way from various perspectives.

—Please find the way by yourself. And, my Factory Management Checklists can help you. Never mind, it is not necessary to pay. 5Ss checklist, Employee Engagement Checklist, etc. Please use this material and understand it.

I then left this company. And almost a month later, I received his invitation once again. And for the first time in 2 months, I visited this company. After the factory tour, we sat down in the same reception room. At this time, the meeting members were different and increased.

1st Consulting global meeting: Factory Management level.
CEO: Chief Executive Officer
QA: Quality Manager
FM: Factory Manager
EM: Engineering Manager
HR Human Resource Manager
Qfs: Quality Staffs

Meeting members to discuss the Factory Management Level: CEO of this company, QA, FM (Factory Manager), EM (Engineering Manager), HR (Human Resources Manager) and Qfs (Quality staff).

After the greetings and introductions of the members, the discussion began.

I will continue this history in the following lecture…

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III. Jishu-Ken IV group exercise: Cost Control[2] [3]

TQM-10 Previous Lecture
JISHU-KEN III.

Let's talk about Cost (Money) in this transcription of the JISHU-KEN working series. At this time, the dialogue shifted to a different topic (cost, money).

The Sales staff (**Sm**) began: —What went after that? Don't you know Mr. **Em**? The issue of our company being on the verge of bankruptcy.

—Mumm —**Em** hesitated—. I also don't have the latest information so far. Even so, our company was falling into a cash-flow shortage.

Mp mentioned then: —As our Financial Manager told our company, we have a defect in the Management Balance. Again, please let me know what the problem is with Management Balance. I want to confirm our understanding regarding the management balance… My understanding of Management Balance is as follows:

---

[2] **Cost reduction/control** is a series of lectures about the interpretation of different costs regarding calculating the Profit and Loss statement adequately depending on the activity and policy of the company:

JISHU-KEN III – Cost Reduction – 10: [eng] https://archive.org/details/tqm-10-the-matrix-diagram-and-qcc-working
JISHU-KEN II – Cost Reduction – 9: [eng] https://archive.org/details/tqm-9-pfmea/page/n35/mode/2up
JISHU-KEN I – Cost Reduction – 8: [eng] https://archive.org/details/tqm-8-the-arrow-diagram/page/n37/mode/2up Example of ***Jishu-Ken*** sessions of a middle managers working group: The group was studying the break-even point of the operations to reach profits in the short and medium term.
Cost Reduction – 7: [eng] https://archive.org/details/tqm-5-the-kj-method/page/n47/mode/2up
Cost Reduction – 6: [eng] https://archive.org/details/tqm-3-hardware-software-diagnose-cost-reduction-6
Cost Reduction – 5: [eng] https://archive.org/details/tqm-2-introduction-2-cost-reduction-5
Cost Reduction – 4: [eng] https://archive.org/details/tpm-16-oil-control-5/page/8/mode/2up
Cost Reduction – 3: [eng] https://archive.org/details/tpm-15-cost-reduction-3-and-consultancy-job-contnuation
Cost Reduction – 2: [eng] https://archive.org/details/tpm-14-clasification-of-cost-and-oiling
Cost Reduction – 1: [eng] https://archive.org/details/tpm-13-oil-control-3/mode/2up

[3] **Teaching Company** is a series of a real story about the implementation of TPM and TQM in a medium-sized company by ***Sensei*** Kimura. They are deployed throughout TPM-7 to TPM-16, which continues within this TQM series. The beginning of this series is in TPM-7:

- [English]
  - TPM-7 page 31 One Lecture in a Company: https://archive.org/details/TPM7SeisoInJishuHozen/page/n29/mode/2up?view=theater
  - **Previous lecture in TQM-7. Page 33**: https://archive.org/details/tqm-7-7new-qc-tools-and-the-tree-diagram/page/n31/mode/2up
- [Spanish]
  - TPM-7 page 31 Una conferencia en la Empresa: https://archive.org/details/TPM7SeisoEnJishuHozen/page/n29/mode/2up?view=theater
  - **Lectura previa en TQM-7. Page 33:** https://archive.org/details/tqm-7-las-7-nuevas-herramienta-de-caliad-y-el-diagrama-de-arbol/page/32/mode/2up

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***4th Jishu-Ken* for Cost Reduction**
Em: Engineering Section Manager.
Pm: Production Section Planning Manager.
Mp: Material Section Procurement Manager.
Hr: Human Resources Staff.
Sm: Sales Staff.

Management Balance refers to how a company balances its resources of human, material, financial, etc. to achieve sustainable growth. This perspective considers the financial indicators, a company's strategy, operational efficiency, and its ability to adapt to market conditions.

Mp continued: —That's true, now I realize that our factory operations were biased. Misunderstanding of factory efficiency. Just seeking factory performance. As a result, it causes numerous problems, including worsening inventory turnover, quality control issues, frozen materials in the warehouse, Obsolescence, and disposal losses, as well as frozen cash. The most severe issue is the cash flow shortages. No cash. And it began the bankruptcy.

—Come on, don't be so pessimistic —**Hr** optimistically questioned **Mp**—. I heard the negotiation by our Managing Director was successful. And headquarters agreed to keep the money supply for the time being.

—Mumm —**Sm** hesitated—, regarding our Managing Director's visit to our headquarters. I was indeed successful in gaining the promise of money supply. However, I still have one concern.

—About money supply? —**Em** questioned **Sm**.

—No, it is not —Answered **Sm**—. I'm concerned about the special project activity, namely DOPE, led by our Head of Quality and his three staff members dispatched from the headquarters.

Now, I have to make an annotation in the conversation as a narrator: Well, DOPE? Sorry, it is my invention. A very similar activity is underway in the US, specifically the DOGE (Development of Government Efficiency) initiative (2025, April). And actually, very similar reform activity was begun in this my teaching company. And "P" means Plant.

The Sm continued: —As we know, a new project had been started, led by one project leader and 3 assistants. Who were dispatched from Headquarters.

—Oh yes —Pm mentioned—, we know very well. It is indeed tough.

The Em intervened to clarify the issue: —We introduced them in the past Management Team meeting. Accounting department was the first batter of this session. And my department also was required to make a session with them. I was required to review the next budget. Then, the project leader required me to cancel the latest equipment introduction and the Edge Computing system in production lines with no condition.

—Like it or not! As you know, our budget plan was already discussed in the management meeting and agreed. But they required me to cancel it. Not only this latest equipment example, but also other ideas were ordered to be withdrawn. His word is just "Where is the money?". He doesn't listen, no matter what I say.

---- (omit. Their whining) ---

Edge Computing system in production line.

Edge computers on manufacturing lines play a multifaceted role in real-time data processing, preventive maintenance, quality control, production efficiency optimization,

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> *and security. This enables manufacturing sites to become smarter, improving productivity, quality, and reducing costs simultaneously. Especially in today's world, where factories are increasingly utilizing IoT and AI, edge computers will become increasingly crucial for efficiently processing growing amounts of data and converting it into valuable insights.*

—DOPE project —resume the **Hr**—. I'm very much worried about this project. But on the other hand, we are indeed on the brink of bankruptcy. For instance, cash-flow shortages. Not only was there a cash-flow shortage, but also, we were in Insolvency in the Balance Sheet. Insolvency and cash flow deterioration are two key financial issues closely related in corporate management. Let me explain these in a moment. I've studied them in my own way.

—First, what is insolvency? —**Hr** asked and answered himself—. It is a condition in which a company's liabilities (loans, accounts payable, etc.) exceed its assets (cash, accounts receivable, equipment, etc.). This is a situation where the net assets on the balance sheet are negative. You get this. Right?

The **Hr** tried to summarize: —In short, a situation where the debt is so high that it cannot be repaid even if all assets are sold. And, what is cash flow deterioration? …You heard the Financial Manager yelling. There is no cash!

—And the Managing Director has talked to the Headquarters, and they have agreed to supply us with money for the time being. The situation is that there are more outflows than inflows of funds —**Hr** explained—. The business cannot continue in a situation where funds to continue day-to-day business activities are being depleted.

The **Em** tried to give some light: —We have 2 devils, haven't we? Are these related to each other and also the bankruptcy?

The **Hr** clarified: —Insolvency and cash flow are not directly related, but they exacerbate each other. And while they do not in themselves directly cause bankruptcy, they worsen cash flow in the following ways, and consequently increase the risk of bankruptcy:

The **Hr** dived deep just a little more. However, I am going to make a parenthesis to clarify here about what represents and the causes of the insolvency according the exposition of the **Hr**:

> First, **insolvency**. And, again, insolvency by itself does not directly cause bankruptcy, but it can worsen cash flow and ultimately increase the risk of bankruptcy in the following ways.
>
> **Decreased creditworthiness**: Insolvent companies lose the trust of their business partners, which can lead to the cancellation of existing transactions or the refusal of new ones. This results in a decline in sales and a deterioration of operating cash flow.
>
> And **Restrictions on financing**… Pursued by more restrictions on financing.
>
> This time, we somehow managed to avoid restrictions on financing from Headquarters but were instead instructed to accept DOPE. Insolvency makes it nearly impossible to obtain new loans from financial institutions. The terms of existing loans may be revised, or early repayment may be

4th *Jishu-Ken* for Cost Reduction
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demanded. New investments from investors also become difficult, limiting financing options.

And then there is a negative spiral: A vicious cycle of "inability to invest for the future," "decline in corporate competitiveness," "decline in profit margins," and "further deterioration of cash flow; Thus, deteriorating cash flow leads to further insolvency…

Deterioration of payment terms: Increased demand for cash payments or advance payments from suppliers. Payment sites (grace period) are shortened, further worsening cash flow. Thus, deterioration of cash flow leads to insolvency. Conversely, deterioration of cash flow can lead to insolvency.

Continued deficit management: Continued deficits reduce assets (especially cash and deposits), forcing the company to rely on borrowings. In our case, this is the case. Borrowings from headquarters are accumulating. After a long period of time, liabilities eventually exceed assets, and the company becomes insolvent.

Increase in non-performing inventory (defective inventory): Excess inventory causes cash to stagnate and deteriorate cash flow. Inventory write-downs will lead to a decline in asset values, increasing the risk of insolvency.

After the thorough presentation by the **Hr**, the **Mp** led to reflect: —Come to think of it, you remember the yellow and red tag in the warehouse, do you? —And he answered himself— Recently, this control activity had been stopped. It was as follows: The definition of Excess inventory is that 3 months' worth of inventory should be tagged using a Yellow tag. And Dead stock is the inventory more than 6 months old should be tagged with a Red tag.

The **Em** tried to clarify the issue, pursuing the idea of going to see: — It is not the "stop", but it is not maintained. I'm concerned about it. Shall we stop this Jishu-ken dialogue a minute and go to the warehouse to look at the situation? …It is just my reflection, and recently I haven't been visiting the warehouse for a while.

—Oh yes, me too —**Pm** agreed and then they went all together to look at the warehouse.

—Mumm —**Hr** hesitated—. I lost my word. How much of inventory at this time?

—It is necessary to measure by Inventory Turnover ratio. Umm —**Em** muttered thinking--. According to the report of latest inventory check by production department, the turnover ratio is 2.0. It is worsening. Why did stop this control system by colour tags?

Pm showed his concern: —I'm not in a position of responsibility for warehouse control, but we need to ask why.

—However —**Sm** pointed out—, warehouse management also belong in Production Department, doesn't it. Are there no conversations in these sessions about Inventory Turnover?

Inventory Turnover.

I know it's a bit late to say that, but the calculation formula is as follows:

$$Monthly\ Inventory\ turnover\ = \frac{Montly\ sales\ ammount}{\substack{actual\ inventory \\ (monthly\ record)}}$$

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But (I believe you know that) this is a shorthand method.

The actual calculation is below:

$$Inventory\ turnover\ = \frac{Cost\ of\ Goods\ sold}{\substack{actual\ inventory \\ (monthly\ record)}}$$

My target companies are manufacturing companies. And in most cases, it is possible to see that the figures for Sales amount are close to the Cost of Goods Sold. At the very least, it is possible to see the trend. Then, I teach this shorthand calculation.

—Mumm —**Pm** muttered—. Yes but. Mumm…

The **Hr** tried to continue with the exposition: —Please let me continue my report —he insisted—. Now the Inventory Turnover is 2.0. Let's consider the meaning of 2.0 as an Inventory Turnover Ratio:

An inventory turns in a year is equivalent to ONE turn that takes about 182.5 days (= 365 ÷ 2.0). It means that it takes half a year to turn inventory. Unfortunately, I'm hearing that we still have cases of delivery delays, despite having a large inventory.

It means that we have many yellow tags and red tags inventories. Calculating, the company holds, on average, about 6 months' worth of inventory. This is just the average of the whole. There is a high risk of funds being fixed as inventory for an extended period of time, resulting in Cash-flow shortages. As a result, the leading cause of cash-flow shortages is this poor inventory turnover. It is indeed ridiculous. Shall we go back to the original meeting room?

Delayed collection of accounts receivable and bad debts leads to a deterioration in Cash flow, due to delays in receiving payments from clients and bad debts. If accounts receivable become uncollectible, the value of assets decreases, and the company approaches insolvency

Relationship between the two: **Insolvency** and **deteriorating cash flow** are not a simple cause-and-effect relationship, but instead they interact with each other:

- Insolvency → Credit deterioration → Deterioration in terms of business and difficulty in raising funds → Deterioration in cash flow → Shortage of funds → Bankruptcy
- Worsening cash flow → Continued deficit → Decrease in assets/increase in liabilities → Insolvency

Notably, the direct cause of a company's actual bankruptcy is worsening cash flow, and insolvency is a factor that increases that risk. No matter how insolvent a company is, it will not go bankrupt as long as it has a good cash flow. However, if the insolvency continues, the cash flow will eventually deteriorate, and the likelihood of bankruptcy will increase.

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The **Pm** confirmed: —It is indeed we are in this condition. And? …How can we get out of this worst situation? Mumm. Expectation to the DOPE group active?

Hr summarized: —This is just a general theory that is introduced in textbooks, Improvement Measures. The main measures to improve cash flow for insolvent companies are as follows:

> **Profit Improvement:** Improve profitability and return to profitability thoroughly reduce costs, and shrink losses

—As we know —**Sm** explained—, our profit margin is increasing after the strategy change. We abandon the expectation of profit for the current main product series and expand the small lot sales.

—Now the sales are keeping up —**Sm** continued—. However, it is also true that the total amount of sales cannot be recovered to the level of the recent past year, and has moved to a small lot order strategy. I believe this is the correct way. But the production capacity and system couldn't be reached.

> **Thorough cash flow management:** Create a cash flow chart to visualize and manage cash flow
>
> Thoroughly collect receivables and negotiate payment site extensions

The **Hr** resumed his conclusions: —Occasionally, we need to have a lecture on the Cash Flow Statement. Because the P/L statement, Balance Sheet and Cash Flow Statement are called the Basic structure of financial statements:

- P/L (Profit and Loss Statement) shows how much profit a company has made
- The balance sheet (B/S) shows how the profits affected the assets and liabilities.
- The C/F (statement of cash flows) shows the actual cash flows

> C/F analysis is also essential because, for example, there are cases where a company has a profit but not enough cash (i.e., a profitable bankruptcy).
>
> **Optimize inventory:** Dispose of non-performing inventory (dead stock) and maintain appropriate inventory levels.
>
> Improve the accuracy of demand forecasting and prevent excess inventory.
>
> It is also quite obvious. Why did the warehouse stop the inventory control by colour tags? … I remember that if the inventory remains over 6 months with no movement, it should be tagged with red tags and moved to a designated area. That means the condition of inventories is mixed, with normal inventories moving between 3 months, excess inventories showing no movement within 3 months, and obsolescence (dead stock), which shows no movement within 6 months. Why did it deteriorate so quickly?

Then, the **Sm** pointed out: —The reasons are pretty straightforward.

And **Sm** detailed one by one: —One is that the receiving order circumstance was changed. Initially, our receiving orders were supported by the past main product series. But the market had changed. And now our so-called main products are small lot size orders, such as products H, W and L. Also, this strategy change has been announced. But our production system hasn't been

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adapted to this significant change. The ***Production-Genba*** insists on thinking in terms of a minimum lot size of production, although it is becoming smaller than in the past. It is too far from the thought of JIT and the /or One-by-one production.

The **Em** clarified his plans, then: —It is indeed our production capacity that couldn't keep up with the business changes. Mumm... —he muttered—. Again, my plan of introducing the latest equipment, which is Multi-axis machine tools and Edge computing systems, was stopped by DOPE. I know it is essential to follow SMED (Single Minute Exchange Die) for quicker changeover to adopt smaller lot size production. Anyway, our production line and equipment are also becoming old. DOPE. Yes, I got that, but still---.

—Anyway —**Hr** continued his speech, not without clarifying the actual overproduction situation.

> **Capital Increase:** Increase capital through a capital increase
>
> Debt forgiveness (transfer to equity) of loans from owners. DES (debt-to-equity)

—I believe our Managing Director is negotiating this point also, isn't he? —the **Pm** asked to the group.

—No —**Hr** pointed out—, it is not. He negotiated just the issue of the cash-flow problem:

> **Business restructuring:** Liquidation of unprofitable businesses and concentration on profitable businesses
>
> Business restructuring through M&A. From the perspective of cash flow management, management decisions must be made to maximize free cash flow by focusing on actual cash flows rather than net income.
>
> Taking measures at an early stage, rather than leaving the company in a state of insolvency, is essential to prevent cash flow deterioration and to ensure the company's survival and recovery.

The **Em** intervened, recovering a passage of the big management meeting: —I cannot forget one scene in the management team meeting that our Financial Director shouted that "we have no cash", and "we are on the brink of bankruptcy". It is my suggestion that we learn more about how to read the Balance Sheet in the next ***Jishu-ken***.

—Thus, Insolvency. Cash Flow shortages. These are appearing in the Balance sheet —**Em** concluded.

—I agree with you —**Hr** expressed—. Insolvency and cash flow shortages. Let me explain where “Insolvency,” “Excessive borrowing from headquarters,” and “Insufficient Cash Flow” appear on the balance sheet.

The following is produced by ChatGPT, because of their insufficient dialogue contents in this occasion and I feel I need to expand some accounting and financial terms:

1. ***Insolvency:*** *insolvency is a situation where total assets are less than total liabilities - on the balance sheet, net assets are negative - total “assets” on the balance sheet minus*

4th *Jishu-Ken* for Cost Reduction
Em: Engineering Section Manager.
Pm: Production Section Planning Manager.
Mp: Material Section Procurement Manager.
Hr: Human Resources Staff.
Sm: Sales Staff.

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total "liabilities" - or total net assets are shown as negative 2. excessive debt - the amount of debt is excessive.

2. ***Excessive borrowings**: borrowings are recorded in the liabilities section on the balance sheet - too much borrowings will increase the debt ratio and affect financial health - it is necessary to determine whether the company has excessive borrowings by looking at the overall balance sheet composition (especially using indicators such as capital adequacy ratio as a reference) - the absolute amount of borrowings The company will be judged in relation to its ability to repay the debt, not just in terms of the absolute amount.*
3. ***Cash flow deficiency:** This does not appear on the balance sheet. But it is relevant. 3. Cash flow is captured in the statement of cash flows (CF) - It does not appear directly on the balance sheet (BS), but is related to the amount of "cash and deposits" on the BS - The "ending balance of cash and cash equivalents" on the last line of the statement of cash flows matches the "cash and deposits" on the BS - Cash Flow Deficiency refers to a decrease in cash and deposits on hand and a lack of working capital for corporate activities Based on this information, summarize your answer as to where each financial problem appears on the balance sheet.*

1. Insolvency

Insolvency is one of the most clearly discernible problems on the balance sheet.

Insolvency is a condition in which the total assets are less than the total liabilities.

It appears on the balance sheet in the following areas:

- *Net assets are negative*
- *Total assets ＜ Total liabilities*
- *The equation "Assets = Liabilities + Net Assets" on the balance sheet is broken down to "Assets = Liabilities - |Net Assets|".*

If the total assets on the left side of the balance sheet minus the total liabilities on the right side of the balance sheet is negative, the company is insolvent. The same applies if the total of net assets is shown as a negative figure.

2. Excessive borrowing

Excessive borrowing appears in the liabilities section of the balance sheet and is determined not only by the simple amount but also by the ratio.

The way it appears on the balance sheet:

- *The amount of "short-term debt" and "long-term debt" in the liabilities section is large.*
- *Equity ratio (net assets divided by total assets) is low*
- *Debt ratio (debt divided by net assets) is high*

To know whether the amount of borrowings is appropriate or not excessive debt, we must look at the balance sheet, not the monthly sales (PL).

Excessive borrowings should be judged in relation to the size of the company and its ability to repay, not in absolute terms.

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3. Cash Flow shortages

Cash flow deficiency or shortage is primarily determined by the cash flow statement but is also closely related to the balance sheet.

How it shows up on the balance sheet:

- *The amount of "cash and deposits" in the Assets section is low.*
- *Cash and deposits" are decreasing when comparing the balance sheet at the beginning of the period and at the end of the period*
- *Current ratio (current assets divided by current liabilities) is low*

The cash flow statement provides a read on the flow of cash (money) that cannot be read in the income statement or balance sheet.

BS and CF are connected by "cash. Specifically, "Cash and cash equivalents at end of period" in the last line of CF matches "Cash and deposits" in BS.

Contents of Balance Sheet	
Current assets	**Current liabilities**
1) Cash and cash equivalents	Notes payable
Cash	Accounts payable
Petty cash	Accounts payable - other
Checking accounts	Accrued expenses
Saving accounts	Advance received
Deposits at notice	Short-term debt
Time deposits within one year	Bonds payable within one year
Notes receivable	Withholding payroll taxes
Accounts receivable	Deferred revenue
Marketable securities	Suspense receipts
Merchandise inventories	Suspense received Accrued consumption tax
Finished goods	Reserve for bonuses
Unreceived goods	Discounted notes payable
Work-in-process & Parts, Materials	Endorsed notes payable
Supplies	**Fixed liabilities**
2) Other current assets	Long-term debt
Short-term loans Suspense payments	Long-term notes payable - equipment **Shareholders' Equity**
Allowance for doubtful accounts	Capital stock
Suspense paid consumption tax	Legal reserve
Fixed assets	Capital reserve
1) Tangible fixed assets	Legal retained earnings
Land	Other capital surpluses
Buildings	Voluntary retained earnings
Building and accessories	Voluntary reserve
Structures Machinery & equipment	Retained earnings Unappropriated retained earnings at the end of period
Vehicles & delivery equipment	
Tools, furniture & fixtures	
Accumulated depreciation	
Construction in progress	
2) Intangible assets	
Goodwill	
Patent	
Trademark rights	
Leasehold rights	
Software	
3) Investments	
Investment securities	
Investments in capital	
Long-term loans	
Security deposits	
Long-term prepaid expenses	
Deferred assets	
Inaugural expense	
Development expense	
Stock issuance expense	

Picture from TQM-5 the KJ method. The QR-link is below.

By Chat GPT

The **Hr** tried to simplify the conclusions: —Anyway, these three issues are often interrelated as next:

- Persistent over-borrowing increases the risk of insolvency
- Insufficient or shortages of cash flow that affect the ability to repay loans and exacerbate over-borrowing
- Companies with excessive debt are more likely to have difficulty obtaining new loans from financial institutions and to suffer from cash flow shortfalls

—As described above, these financial problems appear in different parts of the Balance Sheet, and it is essential to analyze these indicators in relation to each other in order to make a comprehensive judgment of a company's financial health. Our company, unfortunately, relies too heavily on its Headquarters, as has been the practice for many years.

—What should we do in the future, DOPE? —The **Em** asked and answered himself just before any intervention—. I don't like it. When is the next **Jishu-ken**?

The **Mp** answered then: —Why not do it very soon, for instance tomorrow?

The **Em** showed his concerns: —But it is necessary to have some days for the preparation of, for instance, our Balance Sheet. I think there are some hints in the Balance Sheet.

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No, no, no —The **Hr** disagreed energetically—. It is impossible to find the solution in the Balance Sheet, but we could understand and confirm the current corporate situation by numbers.

—Either way —the **Em** rectified—, it is necessary to know the corporate situation by numbers. Shall we ask our Financial Director to provide the latest BS (Balance Sheet) and lecture?

It will be continued in the next lecture…

IV. The Next Lecture.

We continue explaining some Matrix data analysis of the New QC 7 Tools. And expanding the Cost analysis.

Koichi Kimura, CC4 – June – 2025

International Consultant

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